ISASC®

EQUILIBRIUM®

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

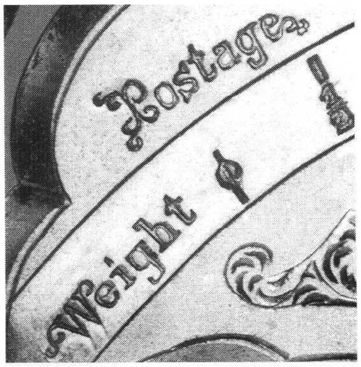
2002—ISSUE NO.1 PAGES 2645-2672

Cover Picture

The Beginners' Guide dealt firstly with equal-arm scales, and secondly with top-pan counter scales. This postal scale is an equal-arm scale, half hanging pan and half roberval combined in a particularly handsome variation. The unusual collar at the bottom of the pillar is unfamiliar and the hanging pan is strikingly substantial. It has a retailer's ivory plaque "ASPREY & SONS, 166 NEW BOND ST, LONDON" but no maker's marks. However, the style of lettering used on the letter plate for the Postal Rates is instantly recognisable.

The distinctive pseudo-Gothic script (shown right) is found only on scales by Auguste Marion & Co, working from 1845 in London, and working from 1855 in London and Paris. From 1870-1920 we only have records of Marion in London. The company were basically wholesale and retail stationers until 1870, then their main business changed mainly to supplying photographic materials. The postal rates are for 1871-97, ie. 1oz 1(d) up to 12oz 4(d).

N SCARRATT Collection



INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

EQUILIBRIUM is published quarterly in January, April, July and October

© 2001 International Society of Antique Scale Collectors ISSN-0893-2883

International Society of Antique Scale Collectors
Founded September 1976
Internal Revenue Service 501 (c) (3) EIN 36-2976411
3616 Noakes St., Los Angeles, 90023
Tel 323.263.6878 **Fax** 323.263.3147
www.isasc.org Thomas_Dooley@bbs.macnexus.org

Directors and Officers 2001*

President. .Thomas Dooley*
Vice Presidents. . . . . Steven Beare*
. . . . Jerome Katz*
. . . . Ruth Hendricks Willard*
. . . . Gerald Wilson*
Secretary . . . . Norman Cima*
Treasurer. . . . . Edward Konowitz*
Executive Secretary . . . . .Jan Macho
President Emeritus. . . . . Bob Stein

For membership information contact
Steven Beare stevebooks@aol.com
7 East Brookland Avenue, Wilmington, DE 19805

Published with the co-operation and support of

ISASC Europe
Founded October 1993
CHARITY COMMISSIIONERS FOR ENGLAND & WALES NO 1037558
P.O. Box 179, Headington D.O. Oxford OX3 9YP

Trustees and Officers 2000-2002*

Chairman . . . . .John Cheeseman
Treasurer . . . . .Ken Govier*
Secretary. Phil Holroyd*
European Representative . . . . . .Serge Camilleri
Meetings Secretary . . . . Janet Scarratt*
Publications Officer . . . . Roy Ladell
Trustee . . . . Brian Stimpson*
Information Officer. . . . . .D Crawforth-Hitchins

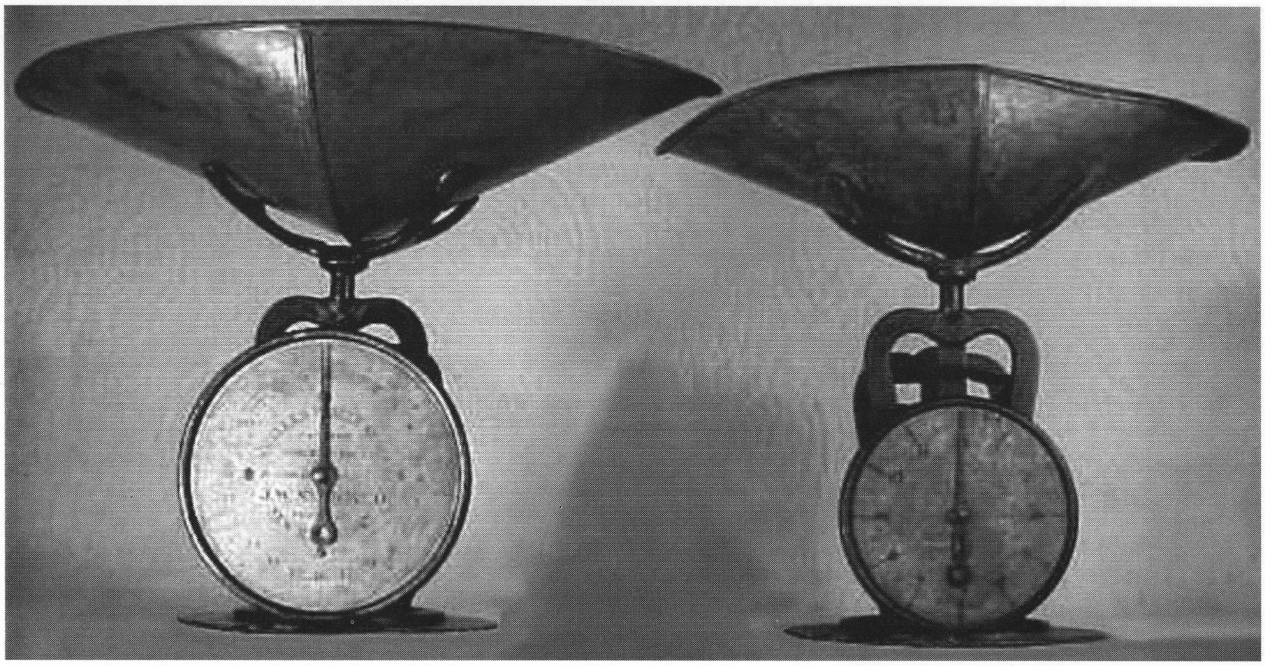
For membership information contact
P.O. Box 179, Headington D.O. Oxford, OX3 9YP, UK

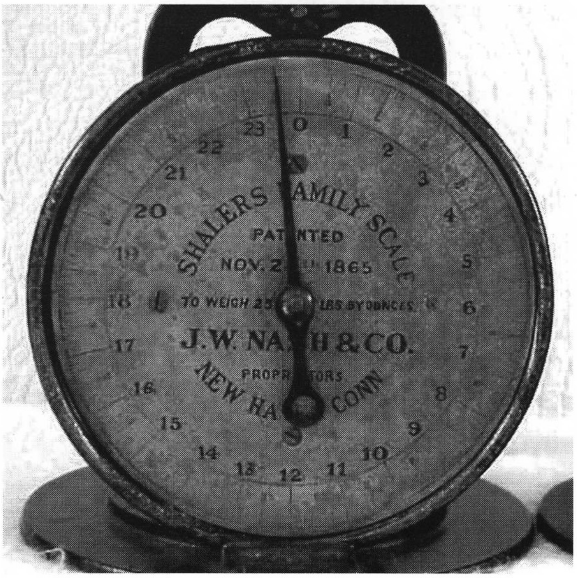
Editor: Diana Crawforth-Hitchins, **Tel** +01865 763096 **Fax** 01865 751797 les.hitchins@bcs.org.uk
Associate Editor: Ruth Hendricks Willard, **Tel** 415.566.9670 **Fax** 415.566.3666 rhwillard@aol.com

Shaler's Spring Balance

BY J BERNING

The Shaler's Family Scale intrigued me when I first saw the photo a collector had sent for use in our book *Scales: A Collector's Guide*. Although the photo was from a strange angle, I knew it was a different type of family spring scale that I had not seen in some 20-plus years of scale collecting. Rather than the boxy, closed-in look of most common scales of that type, its works were exposed for viewing. Its main supports had a more curvilinear, deco look and its base appeared to be circular rather than the familiar rectangle of most family scales that I had in my collection. Its patent date of November 28th 1865 was also earlier than many family scales I had seen. The Shaler's scale as pictured in our book had a 24 pound capacity and a round load plate.

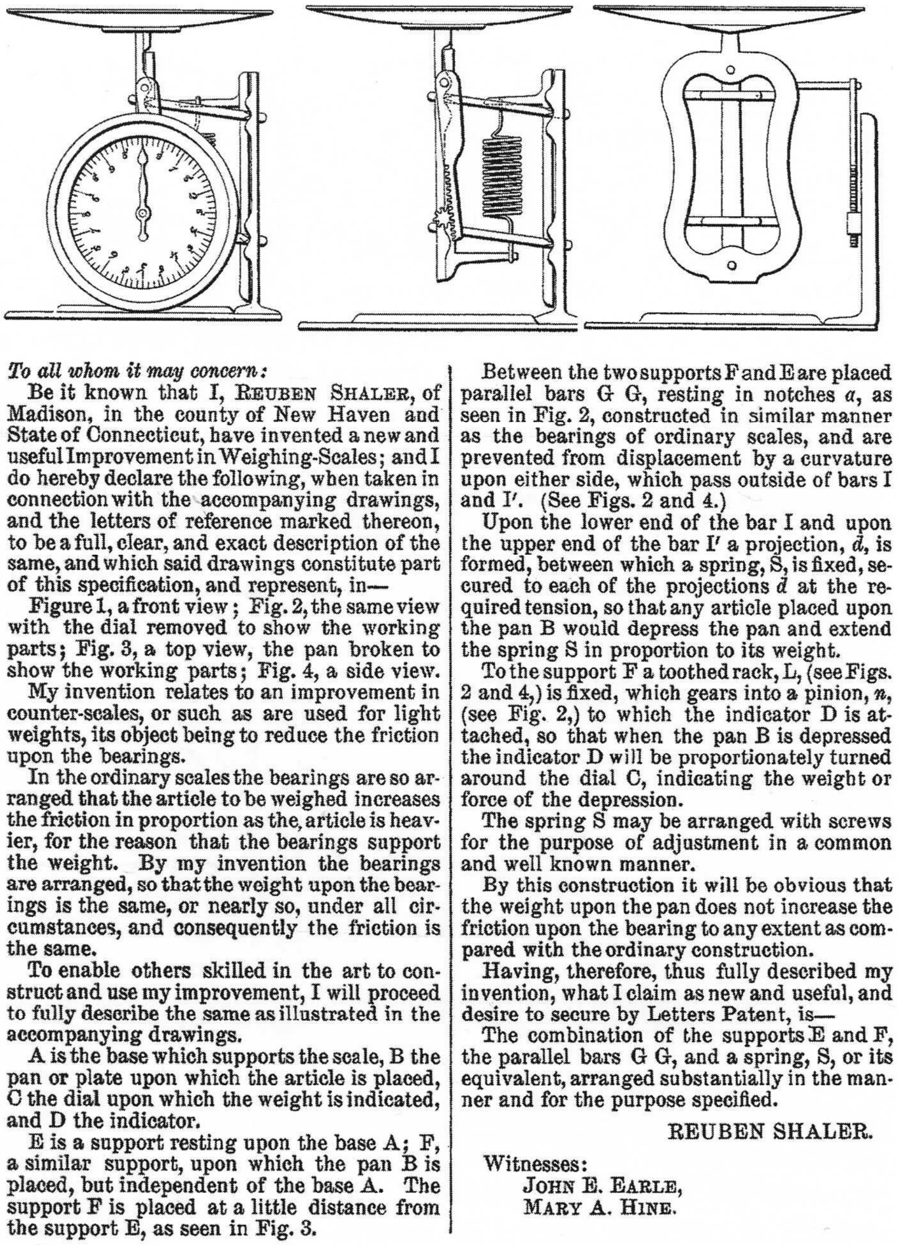




Last year I came across a scale that looked vaguely familiar even though the photo was dark and taken from a bad angle. It had a scoop load pan and the numerals had been written on with marker. I soon realized that it only had a 12lb capacity and the spring of this smaller Shaler's Family Scale was exposed rather than covered like the one in our book. The only other differences were that the face of the dial was smaller to accommodate the 12lb capacity and the base was a circular ring with no support for the spring cover.

Later in the year I came across another Shaler's at auction and the face was in much better condition than the one I had gotten earlier in the year. The auction photo was of poor quality and a novice collector might not have noticed that it was different from any of the other common family scales. I decided that I could buy this one and copy the face and then sell one. When I got this second one

I realized that I must keep them both since this newest one was a 24 pound capacity Shaler's Family Scale with a scoop like my 12lb capacity scale but with a much better dial face and excellent original paint. In the larger, 24 pound cap-acity, scale the spring is hidden within a cast-iron cylinder. In comparing the three scales it is clear that the design was well executed for its intended use, as well as aesthetically pleasing to look at as a decorative yet practical utensil for the late 19th century kitchen.



To all whom it may concern:

Be it known that I, Reuben Shaler, of Madison, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Weighing-Scales; and I do hereby declare the following, when taken in connection with the accompanying drawings, and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a front view; Fig. 2, the same view with the dial removed to show the working parts; Fig. 3, a top view, the pan broken to show the working parts; Fig. 4, a side view.

My invention relates to an improvement in counter-scales, or such as are used for light weights, its object being to reduce the friction upon the bearings.

In the ordinary scales the bearings are so arranged that the article to be weighed increases the friction in proportion as the article is heavier, for the reason that the bearings support the weight. By my invention the bearings are arranged, so that the weight upon the bearings is the same, or nearly so, under all circumstances, and consequently the friction is the same.

To enable others skilled in the art to construct and use my improvement, I will proceed to fully describe the same as illustrated in the accompanying drawings.

A is the base which supports the scale, B the pan or plate upon which the article is placed, C the dial upon which the weight is indicated, and D the indicator.

E is a support resting upon the base A; F, a similar support, upon which the pan B is placed, but independent of the base A. The support F is placed at a little distance from the support E, as seen in Fig. 3.

Between the two supports F and E are placed parallel bars G G, resting in notches *a*, as seen in Fig. 2, constructed in similar manner as the bearings of ordinary scales, and are prevented from displacement by a curvature upon either side, which pass outside of bars I and I′. (See Figs. 2 and 4.)

Upon the lower end of the bar I and upon the upper end of the bar I′ a projection, *d*, is formed, between which a spring, S, is fixed, secured to each of the projections *d* at the required tension, so that any article placed upon the pan B would depress the pan and extend the spring S in proportion to its weight.

To the support F a toothed rack, L, (see Figs. 2 and 4,) is fixed, which gears into a pinion, *n*, (see Fig. 2,) to which the indicator D is attached, so that when the pan B is depressed the indicator D will be proportionately turned around the dial C, indicating the weight or force of the depression.

The spring S may be arranged with screws for the purpose of adjustment in a common and well known manner.

By this construction it will be obvious that the weight upon the pan does not increase the friction upon the bearing to any extent as compared with the ordinary construction.

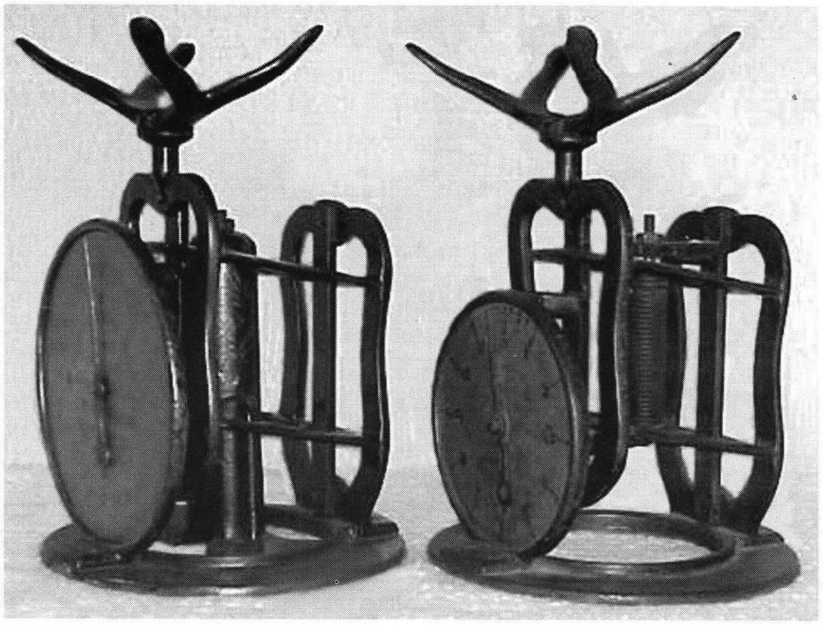
Having, therefore, thus fully described my invention, what I claim as new and useful, and desire to secure by Letters Patent, is—

The combination of the supports E and F, the parallel bars G G, and a spring, S, or its equivalent, arranged substantially in the manner and for the purpose specified.

REUBEN SHALER.

Witnesses:
John E. Earle,
Mary A. Hine.

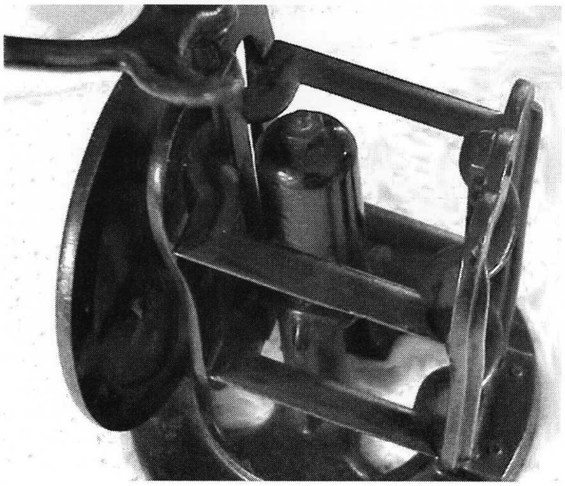
Upon exploring the U.S. Patent Office's web site, I was able to download and print out a copy of the patent, shown above. I discovered that the Patent was issued to Reuben Shaler of Madison, Connecticut and that Madison was in New Haven County. By studying the scale along with the patent drawings and description, one can see that there is little friction upon applying a load to the scale for weighing. The larger capacity scale has a smooth and noiseless mechanism when in use. The user hears the smaller capacity scale only because the rack and pinion, which drives the hand around the dial, is dirty. Both scales are supported on the base in the front by the dial being attached with two screws as well as in the back by the upright curvilinear support that is secured to the base by two screws. Another curvilinear support, directly behind the dial, supports the rack as well as the load pan or plate but is not attached to the base. Both of the curvilinear supports have an additional support bar that divides them symmetrically from top to bottom. The outside of each of the supports has two notches in which are resting two parallel bars which act as bearings. These bearings are kept in place by the notches as well as the fact that they go around the central dividing support bar. In the center of the larger capacity Shaler's Scale there is cast into and integral with the base, a heavy-duty spring casing that completely obscures the spring from view. In the smaller capacity scale the spring is completely exposed to view. Both scales also have, at the top of their spring or spring casing, a screw in order to adjust the scale to zero.



While using the U.S. Patent Office's web site, the small number of patents for spring balances was striking. I didn't expect to find too many, as the basic idea has been used through the 18th century in Europe, and from around 1840-42 by Chatillon and Morton & Bremner. The first three patents, in 1844, and 1845, were combining platform scales with a spring, and the fourth was for a butcher's knife with a scale in the handle that would be familiar to any fisherman.

The first one that I recognised as a real scale was the Turnbull patent of 1859 that sold very well for many years. It, like our Shaler, combined a half-roberval linkage with a spring and full dial face, but it was much heavier and more suitable for store use. The 1861 pen was a simple practical idea, but the 1862 spring balance without a cover over the spring seems less practical. But Mr. Beach of New York was assigned the patent, so he obviously thought it had potential.

A Frenchman patented his spring weighbridge in 1862. Was he planning to import them? The weighing bucket of 1865 would have worked, but it would have been very expensive to make compared with a Chatillon doing the same job. The 1865 platform on springs would have been sticky in operation, if the load was not precisely in the center. Then came Reuben Shaler's sensible design, the forerunner of so many half-roberval and dial scales with a top-pan.



Author's biography see EQM, page 2140.

All photos by the author

.

See more US patents on pages 2663-2671.

Diamond Scales Part 2

BY C SAIT

In the first part of this series of three, a long period of the history of diamonds up to the tumultuous events of World War 1 was covered rather sketchily. Between 1914 and 1918 so much changed that the many books written do not cover even the smallest part of what happened. Metrication in the weighing of diamonds was introduced over a very short time, with South Africa finally signing up in 1923. Uses were found for the oddly shaped, discoloured, small, not very attractive majority of stones mined (approximately 75% of natural production). Scientists, engineers, new machine methods and new materials were finding that diamond tools met a need in industry. It continues today.

Take, for instance, the aircraft industry. From the wood, string and glue fighter planes of WW1 to stealth bombers 80 years later; from crude piston engines to the modern jet; with the revolutionary materials came the need to accurately machine them, and this could only be

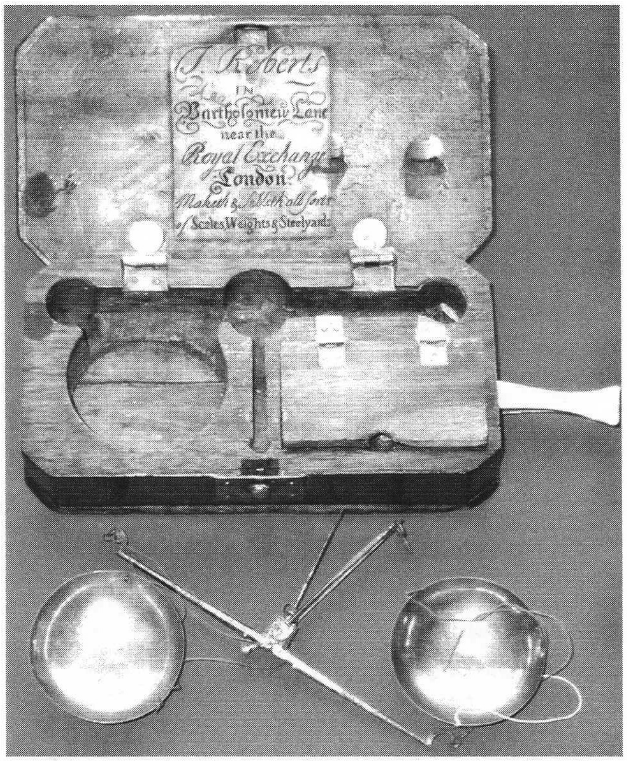


Fig. 5. ▲▲ A pocket set by T Roberts of Bartholomew Lane near the Royal Exchange in London. Bartholomew Lane was also near the Bank of England and the Mansion House. The label is cut from his three-panel trade card, using only the left panel. This set, made between 1693 and 1731, is immaculate in its detail and workmanship, considering the basic tools available at the time.

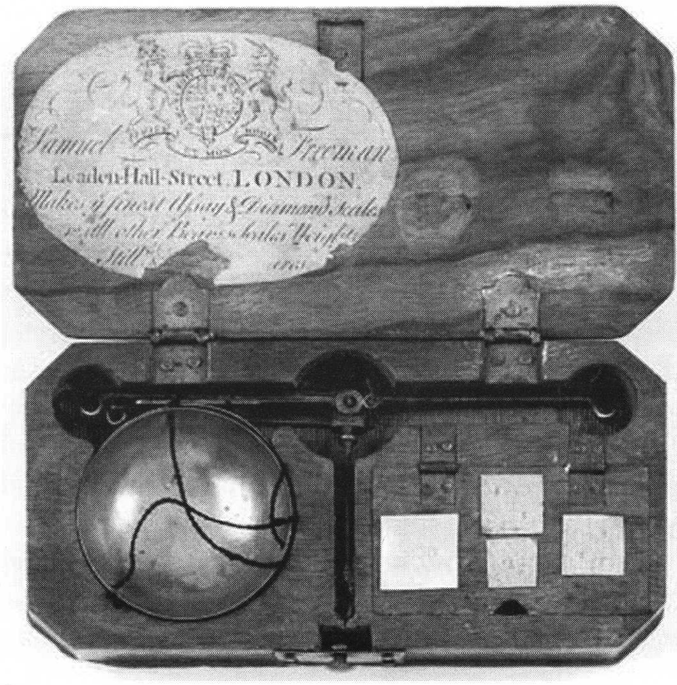

Samuel Freeman
LeadenHall-Street LONDON.
Makes ye finest Assay & Diamond Scales
wth all other Beams Scales Weights
Still

Fig. 6. ◀◀ A pocket set $4\frac{3}{8}$ins (80mm) wide by *Samuel Freeman, Leadenhall Street, London Makes ye finest Assay & Diamond Scales wth all other Beams, Scales, Weights Still...* Three generations were called Samuel Freeman, so only the style can be used to date this label and box. The Coat of Arms was used from 1714 until 1800, the lack of a street number suggests a date before 1765 and the spelling of steelyard as 'stilliard' suggests a date before about 1760. As Samuel Freeman II worked with his son from 1752 until his death in 1757, this suggests a date before 1752. Note the additional weights inserted into holes in the locker lid.

The use of a special label specifically for assay and diamond scales is very unusual. This family seems to have specialised in making coin scales, judging from the large number of coin scales that have survived, yet they had a special label separately printed for putting into diamond scales.

Courtesy Christie's South Kensington

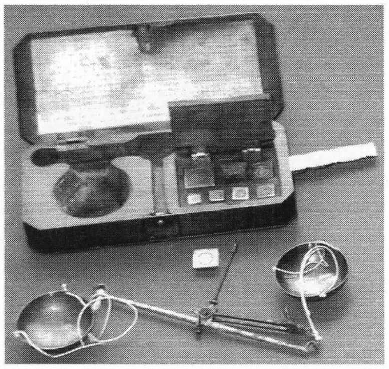
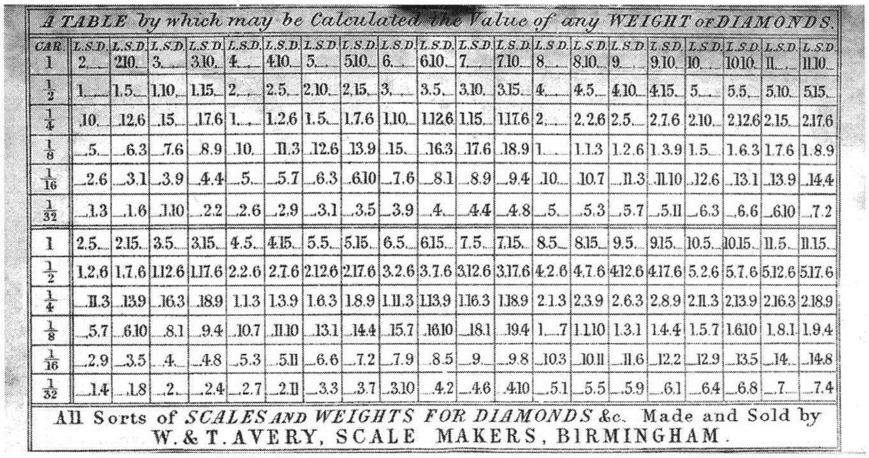


Fig. 7. ≺≺ By Thomas Williams of No. 71 Cannon Street, London. Cannon Street runs approximately parallel to Poultry. With Hatton Garden nearby, it is clear that the diamond industry was very strong in the area. Note the indent under the 32 carat weight where the fractional weights were housed. Thomas Williams is known to have worked at 71 Cannon St between 1783 and 1832.

Fig. 8. ⋎⋎ A similar chart to that used by Thomas Williams by which "The value of any weight of diamond may be calculated". It is not immediately clear how this chart works, but possibly the diamond merchant calculated, using his experience, the value of the diamond (its clarity, cut, and colour) at say, £10..10..0 per carat, then got its weight of 3$^{17}/_{32}$ carats, and used the chart to total up the price of 3 carats at £31..10 plus $^{1}/_{2}$ carat at £5..5..0, plus a $^{1}/_{32}$ carat at 6s..0. Total, £37..1..0. Not quite "calculating" by modern standards, but using the chart as a Ready Reckoner.



A TABLE by which may be Calculated the Value of any WEIGHT OF DIAMONDS.

CAR.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.	L.S.D.
1	2.	2.10.	3.	3.10.	4.	4.10.	5.	5.10.	6.	6.10.	7.	7.10.	8.	8.10.	9.	9.10.	10.	10.10.	11.	11.10.
$\frac{1}{2}$	1.	1.5.	1.10.	1.15.	2.	2.5.	2.10.	2.15.	3.	3.5.	3.10.	3.15.	4.	4.5.	4.10.	4.15.	5.	5.5.	5.10.	5.15.
$\frac{1}{4}$	.10.	.12.6	.15.	.17.6	1.	1.2.6	1.5.	1.7.6	1.10.	1.12.6	1.15.	1.17.6	2.	2.2.6	2.5.	2.7.6	2.10.	2.12.6	2.15.	2.17.6
$\frac{1}{8}$	.5.	.6.3	.7.6	.8.9	.10.	.11.3	.12.6	.13.9	.15.	.16.3	.17.6	.18.9	1.	1.1.3	1.2.6	1.3.9	1.5.	1.6.3	1.7.6	1.8.9
$\frac{1}{16}$	.2.6	.3.1	.3.9	.4.4	.5.	.5.7	.6.3	.6.10	.7.6	.8.1	.8.9	.9.4	.10.	.10.7	.11.3	.11.10	.12.6	.13.1	.13.9	.14.4
$\frac{1}{32}$	.1.3	.1.6	.1.10	.2.2	.2.6	.2.9	.3.1	.3.5	.3.9	.4.	.4.4	.4.8	.5.	.5.3	.5.7	.5.11	.6.3	.6.6	.6.10	.7.2
1	2.5.	2.15.	3.5.	3.15.	4.5.	4.15.	5.5.	5.15.	6.5.	6.15.	7.5.	7.15.	8.5.	8.15.	9.5.	9.15.	10.5.	10.15.	11.5.	11.15.
$\frac{1}{2}$	1.2.6	1.7.6	1.12.6	1.17.6	2.2.6	2.7.6	2.12.6	2.17.6	3.2.6	3.7.6	3.12.6	3.17.6	4.2.6	4.7.6	4.12.6	4.17.6	5.2.6	5.7.6	5.12.6	5.17.6
$\frac{1}{4}$	.11.3	.13.9	.16.3	.18.9	1.1.3	1.3.9	1.6.3	1.8.9	1.11.3	1.13.9	1.16.3	1.18.9	2.1.3	2.3.9	2.6.3	2.8.9	2.11.3	2.13.9	2.16.3	2.18.9
$\frac{1}{8}$	.5.7	.6.10	.8.1	.9.4	.10.7	.11.10	.13.1	.14.4	.15.7	.16.10	.18.1	.19.4	1..7	1.1.10	1.3.1	1.4.4	1.5.7	1.6.10	1.8.1	1.9.4
$\frac{1}{16}$	.2.9	.3.5	.4.	.4.8	.5.3	.5.11	.6.6	.7.2	.7.9	.8.5	.9.	.9.8	.10.3	.10.11	.11.6	.12.2	.12.9	.13.5	.14.	.14.8
$\frac{1}{32}$	.1.4	.1.8	.2.	.2.4	.2.7	.2.11	.3.3	.3.7	.3.10	.4.2	.4.6	.4.10	.5.1	.5.5	.5.9	.6.1	.6.4	.6.8	.7.	.7.4

All Sorts of *SCALES AND WEIGHTS FOR DIAMONDS* &c. Made and Sold by
W. & T. AVERY, SCALE MAKERS, BIRMINGHAM.

done successfully with the diamond tool.

I am told that in the early 1920s great pain was generated when a tooth was drilled because of the use of worn bits. Nowadays, diamond-coated tools coupled with high-speed equipment mean tooth-drilling is not treated with so much fear as it was - by some.

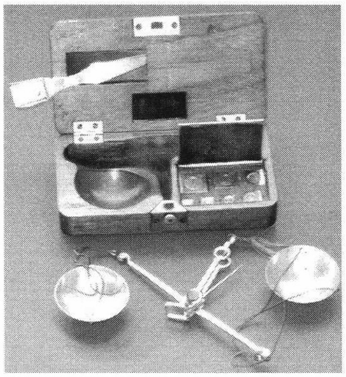


Fig. 9. ⅄⅄ A more modern unmarked Continental example showing where the tweezers were held. These fitted neatly into the only remaining space in the box - the domed lid. Note that one end forms tweezers and the other a diamond shovel, a feature added when it was realised that constant handling of both diamond and weights could change the value of either from finger sweat and dirt.

Every inch of copper wire used throughout the world is made by pulling the copper through a hole in a diamond. Tunnels are bored using diamond-tipped bits, fish fingers are cut with diamond-edged cut-off wheels and jet aircraft engines have blades which are held in place with components that are machined with diamond tools; the list is almost becoming endless.

A basic theoretical tool is made thus. A known weight of diamond powder (of accurately-sieved size) is mixed with a bond. The resulting mix is tamped onto the rim of a pre-machined steel blank in a mould. It is fired in a kiln, removed, cooled and dressed with a soft abrasive to ensure that particles of diamond stand proud of the bond.

The weights I collect are of course

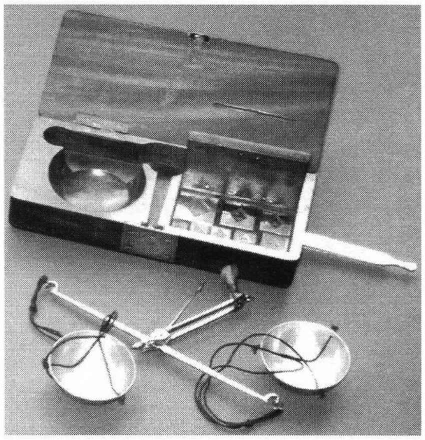


Fig. 10. ≻≻ British scale again unmarked, but showing a more rare pattern around the number - a diamond as opposed to a circle in all the others. Note the long groove cut in the lid to accommodate the piano-hinge of the locker.

worn ones. Working with abrasive diamond meant that careful watch had to be kept on the CM weights used. These were gradually phased out as electronic balances took over. They were enclosed in glass and measured far more accurately.

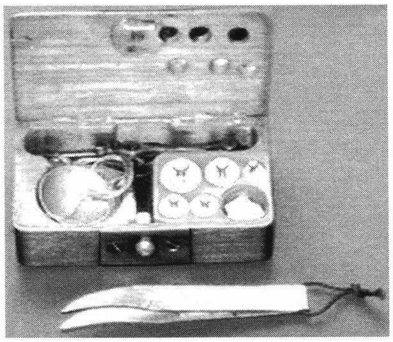
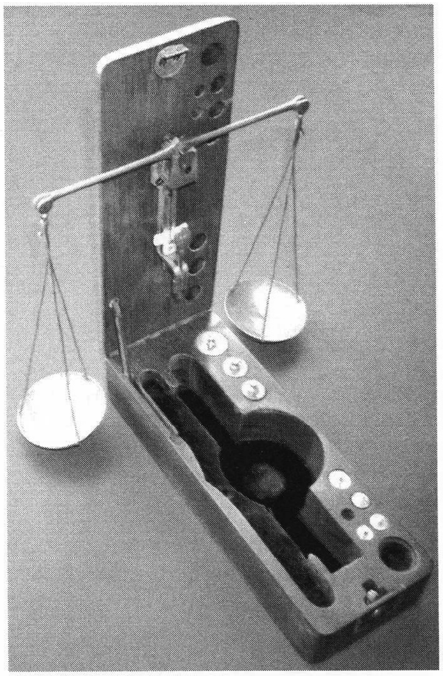


Fig. 11. ◀◀ A small well-made Continental set with knobbed CM weights.

Fig. 12. ▶▶ Another Continental pocket set which can be assembled in situ for immediate use. CM weights. The beam is lifted up from the fulcrum and placed in the recess in the box for storage. The fulcrum only rises to meet the beam when the lever is depressed. The fractional weights were originally stored in the front hole, with a circular lid to hold them in. A small stay props the lid open to prevent accidental shutting of the box during use. All metal parts are chromium-plated.

Americans will be familiar with this box being sold for other purposes; with gramme weights up to 10 grammes for assaying; with assay ton weights for use as a pulp scale or for assaying; with gramme, grain or dram and scruple weights for a surgeon's pocket prescription scale.



In the late 1930s efforts were being made to avert another war. A Mr. Neven was working hard at producing diamond tools at his company in Belgium. He believed that, as war was inevitable, he should go somewhere safer to work. With all his equipment, staff and stock, he ended up in Gloucester in England, starting production just before the outbreak of the war. With the acceleration provided by war-production, his company grew into one of the big names in quality diamond-tool manufacture in the world.

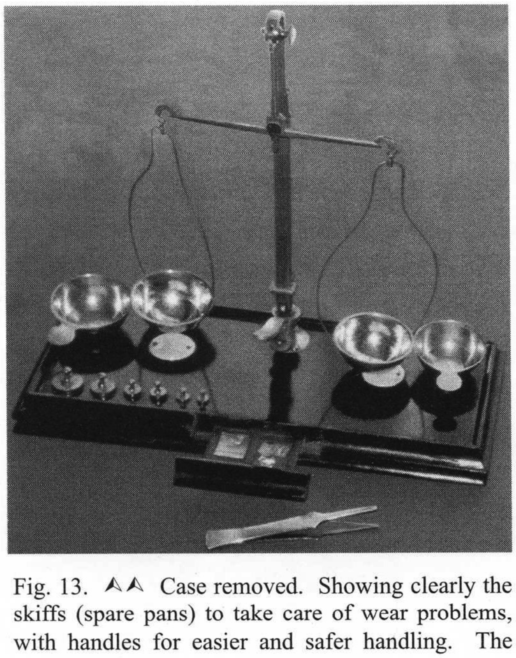
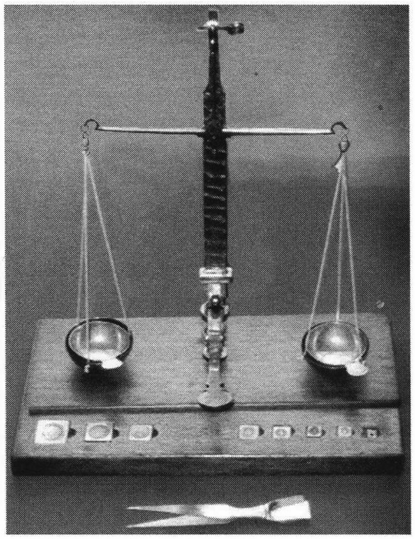


Fig. 13. ▲▲ Case removed. Showing clearly the skiffs (spare pans) to take care of wear problems, with handles for easier and safer handling. The fractional weights are housed in the small drawer at the front. Lever lift. With the round knobbed CM weights it is thought that this unmarked set is possibly French.

Another story well-documented now, (but top-secret at the time), concerns J K Smit Jnr. He was living in the UK and was the agent for his father's company of diamond traders in the Netherlands. The Netherlands at this time was rapidly being occupied by the advancing Germans and the UK Government was concerned that the vast stock of diamonds in that country would be captured. Mr. Smit Snr. contacted all the dealers and suggested that he send to England all the jewels that could be mustered. A small party, including his son, left Harwich in a Royal Navy destroyer, HMS Walpole, with instructions that they were to go straight there and bring the diamonds straight back. One of the crew made a kitbag to hold the stones which were collected from the individual suppliers with only a pencilled or verbal receipt given. Mr. Smit filled the kitbag and it was brought back to England.[1]

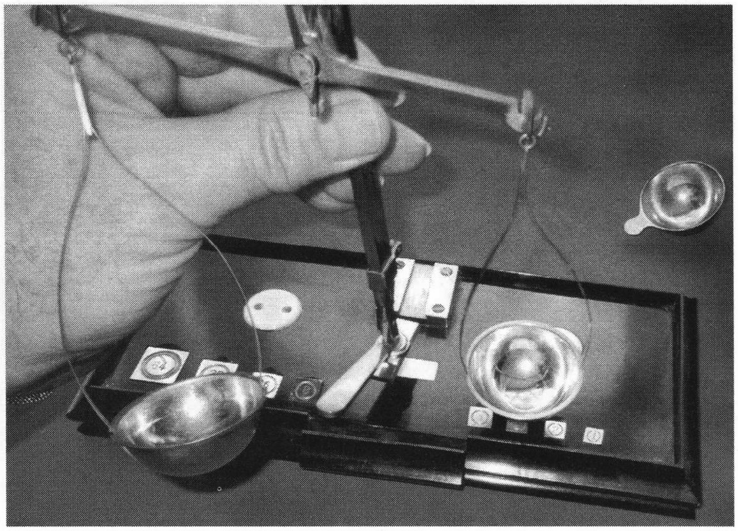
Fig. 14. ➤➤ Made by W & T Avery with original pre-metric tapered weights, up to 64 carats, the smallest version offered. In 1885 this set was offered with capacity up to 1000 carats. It had a brass pillar with gun-metal slide, and brass pans, but the whole could be nickel-plated for 12% extra cost. There is nowhere to house any fractional weights but as this was for industrial use this gives the normal limits of accuracy. This set was in use up to about 1970.



With the need for diamond-tools being greater than the need for gems, it is possible that some of those gemstones found their way into the tools required for making arms and ammunition for the war effort, possibly through Peter Neven. It can be imagined that the diamonds in Amsterdam were weighed with scales of the type shown in Figs 9, 10, 11 and 12. Similar small but practical scale are still sold today. One problem with this type is that the diamonds go directly into the pan. Being abrasive, diamonds wear away the pans, making them inaccurate, but they are not intended to be ultra-precise.

Greater precision was obtained when mechanical balances were the only ones to be had. This was using double-pan application. It is obvious that pans needed to be deep to hold the valuable material that diamond is. Because of the abrasiveness they had to be nickel- or chromium-plated. See fig. 13, 14 and 15. By making a pair of miniature skiffs which fitted inside the scale pans, wear could be taken by these throw-away extras and a reasonable measure of accuracy achieved. Loading the diamonds into a skiff could be carried out beside the delicate balance so reducing wear through possible spillage and the load could be placed on the scale pan using the lip on the skiff. The design of some of these interesting balances is a fascinating study.

Another accessory for weighing diamonds and also gems in general is the tweezers. These consist of normal



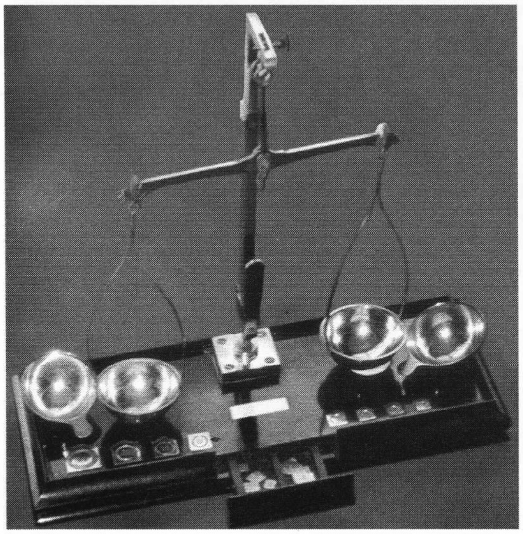


Fig. 15. ⮝⮝ ⮜⮜ Another delightfully-made set by an unknown maker. (Editor - The highly-polished label has long since become illegible, but the balance is like those made by David Koritschoner of London in the last quarter of the 19th century.) With plated carat weights and a drawer for the small weights, it conforms to a reasonably standard design except for the fitting for the post. This is in the form of a double taper which, when slipped home, makes an excellent fit.

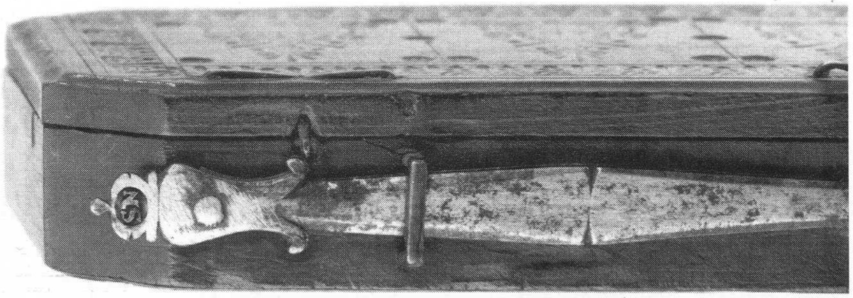


Fig. 16. ▲▲ Close-up of tweezers from a set by Samuel Neale, who stopped working in 1690. The tweezers were stored at the back of the box, fitting tightly in a pair of brackets. Note his initials SN stamped at the top.
The set must have been made towards the end of Neale's career, because the box was stamped by one of the box-makers working from about 1690 to 1710, and because the pointer was of the new round-section that was first made in about 1690.
Courtesy Christie's South Kensington.

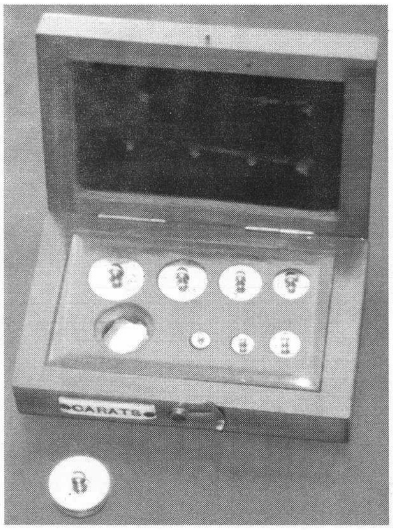
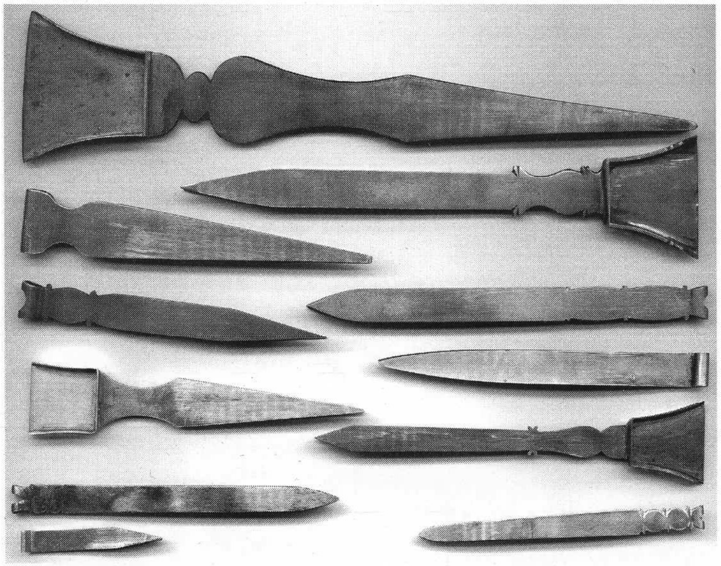


Fig. 17 ◄◄ A small smart set of well-kept standard weights which was probably used by the Inspectorate to check the carat weights.

Fig. 18. ▼▼ A variety of tweezers for diamonds from about 1700-1930, from Britain, Amsterdam and Antwerp.



sharp-pointed prongs for lifting the weights cleanly. This is normal laboratory procedure. The later tweezers have a shovel with raised sides for shovelling the stones onto the pans. These were usually sold with the small pocket boxed sets where there was a slot for housing them. See Fig. 9.

The range of mechanical scales used in not only industry but the gem trade too, lasted for a long time and some are still in use today. However by looking at the growing range of applications where diamonds have made a difference, there was an obvious need for a speedier process for weighing them. To have someone sitting down weighing out small individual amounts of stones needed fresh thinking to speed the process up. Electronic weighing became the answer. Coupled with this was the need for the supply to increase but this will all be dealt with in Part 3.

Notes & References

1. An interesting story within this story is of how HMS Walpole was given a course through two mine-fields, was told not to engage the enemy and to sail at least 14 miles away from any ship coming in the opposite direction. This was all to take place at night with no lights or radar. At one point while at maximum speed, the ship's company sensed another ship passing at full speed in the opposite direction. The Captain, Commander H G Bowerman, recorded that he could have thrown a cricket ball and hit it. It transpired that the other ship was HMS Codrington carrying the Dutch Royal family to England.

Beginners' Guide Part 3

Equal-arm scales and their accessories

Part 1 dealt with equal-arm scales with hanging pans, Part 2 dealt with top-pan equal-arm scales, and this part deals with the extras that divert the eye from the basic scales and make collecting such fun.

But before dealing with the accessories, here is a quotation from Henry Troemner's catalogue of 1926, printed below a picture of an equal-arm, hanging pan scale, Fig. 1. *It being constructed on the "balance" principle - weight below the center - it will weigh more accurately and maintain its sensibility. .... This balance has but three points of contact, and these on agate bearings, and these contact points being at the top, well out of reach of the brine, there will be no danger from rust or corrosion; a very common defect in all weight-above-the-center types, with the necessary tie-rods in the base, to rust and corrode and thus rapidly destroy the sensitiveness and accuracy of the Scale.* Of course, Troemner offers the very type he condemns on the next page, Fig. 2, but that's business!

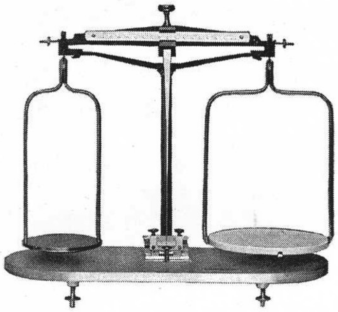


Fig. 1. ▲▲ Print Butter Test Balance by Henry Troemner, 1926. It has a rider bar in front of and attached to the beam, showing 10 each side of zero.

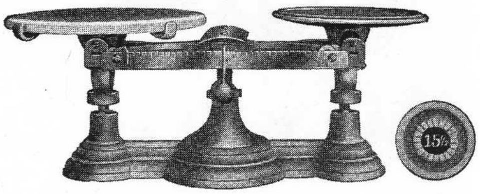


Fig. 2. ▲▲ Henry Troemner 1926 Print Butter Test Scale, galvanised to protect the scale from the corrosive effects of brine. The "side beam" (along the front) is graduated both sides of centre from $^{1}/_{16}$oz to 1oz. A 15$^{1}/_{2}$oz galvanised iron weight *lends itself more readily to setting the machine to run the full pound print. 1-lb full weight supplied instead if required.*

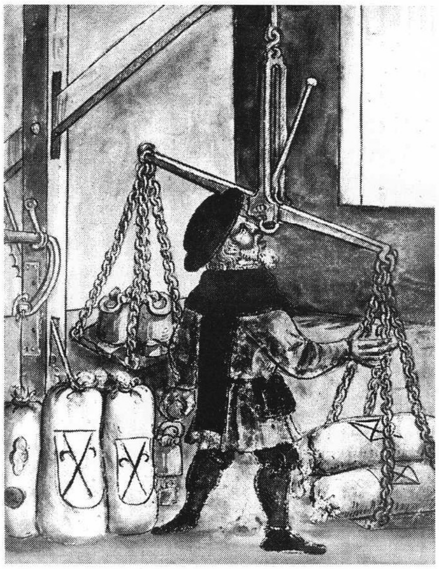


Fig. 3. ▲▲ Nuremberg, 1544. The scales have been raised to check the load, using the winding handle on the left side, and the handle is locked.

Arrestments

From at least the mid-16th century, users prolonged, without realising that they were doing so, the accuracy of the bearings by resting the pans on its base because they wanted the pans stationary while they loaded. The illustration, done in 1544 in Nuremberg, shows a pivoting bar supporting the balance. The bar is raised by turning a handle operating a rachet. The handle is shown locked by a long hook while the merchant adds a ring weight. Cord lifts were used with a lump at the end of the cord, to hold up the balance while the weight was assessed.

The bearings were intentionally relieved on Cavendish's balance made by an unknown maker (possibly called Harrison) in about 1780. Cavendish arranged to have the pans swinging freely just momentarily while assessing the weight, by having fully adjustable supports under the end bearings. See Figs. 5 & 6. Cavendish would only have needed to use cradles because the bearings were of a novel design that had to be located on the planes each time the balance was used. As Cavendish was a scientist, his ideas on bearings would not have seeped out to the general scale-makers immediately, and it seems probable that scale-makers only became aware of relieving when they saw the many beautiful precision balances made by T C Robinson from 1825 to the 1840s.

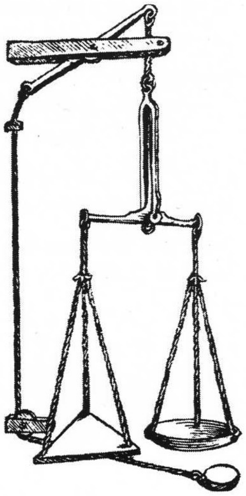


Fig. 4. ➤➤ Basel, 1557. These scales are much smaller than the ones in Fig. 3, and are operated by pulling the heavy lumpshown in the bottom right corner. The use of a lump to hold the weight of scales, load and weights continued for another 200 years. How much better to have a handle out to one side!

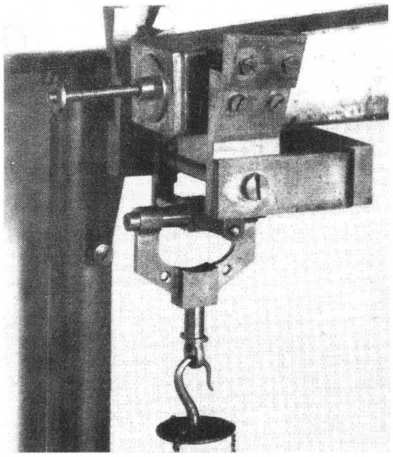


Fig. 5. ≺≺ Cavendish design, built c.1780. This fully adjustable cradle arrestment was not improved on for another 70 years, but was rarely used, probably because it was so difficult to make. The frame holding the cradle is behind the beam, not directly underneath, as in later designs.

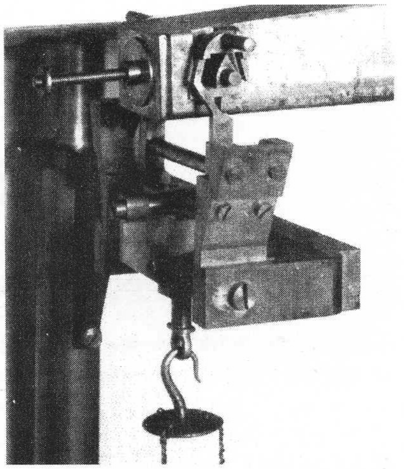
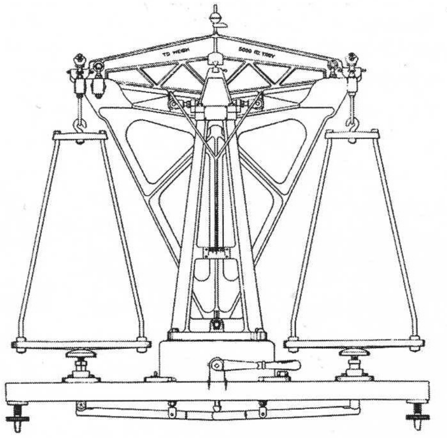


Fig. 6. ≻≻ The cradle drops, leaving the beam to swing freely. The novel plane is exceptionally long, and can be seen here, looking like a long thin bar.

Fig. 7. ⋎⋎ W & T Avery Ltd. c.1922. As G A Owen said,[1] *To relieve the knife-edges from wear when the balance is not in use a triangular frame is provided, and is lifted and lowered by a cam mechanism operated by a handle at the foot of the balance. The frame moves vertically in roller guides fixed on the stand. On the upward movement of the frame the vertical crutches near its ends first lift the end bearings off their knife-edges. As the frame continues its upward motion the upright pins near its ends engage studs which project horizontally from the beam, and lift the fulcrum knife-edge from its bearing. Pan rests, operating concurrently with the sliding frame, hold the pans steady whilst the load is applied.*



T C Robinson probably copied his first relieving design in 1822 from John Corless, but he reverted to the Cavendish design by about 1825. Robinson later worked with Barrow, who produced the finest, adjustable design with eight screws on each cradle.

Oertling thought about a new design of relieving mechanism. In 1848 Oertling Balance 6 specifically offers *apparatus for steadying the pans connected with the same axis which moves the beam, so that one movement first releases the pans and then the beam. 1$^1/_2$ guineas extra*. The British were apparently the only nation using arrestments until about 1830, after which the Germans incorporated arrestment-mechanisms into their precision balances.

So the scientific end of the market used planes and relieving mechanisms, Fig. 7, while the trade end of the market used V-shaped "planes" and needed only to loosen the cords slightly when the scales were not in use. So the trade had cord-lifts and slide lifts, with a few fancy variations, Fig. 8, and inspectors and weighers of bullion joined the scientific fraternity to use rugged frames to support the beam and allow full arrestment.

Cases and Containers

Another delightful part of collecting. Boxes were the cheap and easy bit, made of local products, and intended to hold the fiddly bits securely, and possibly to impress friends too. Plain wooden boxes could have individual holes dug into

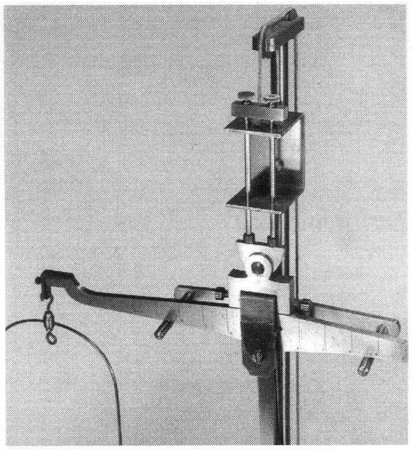
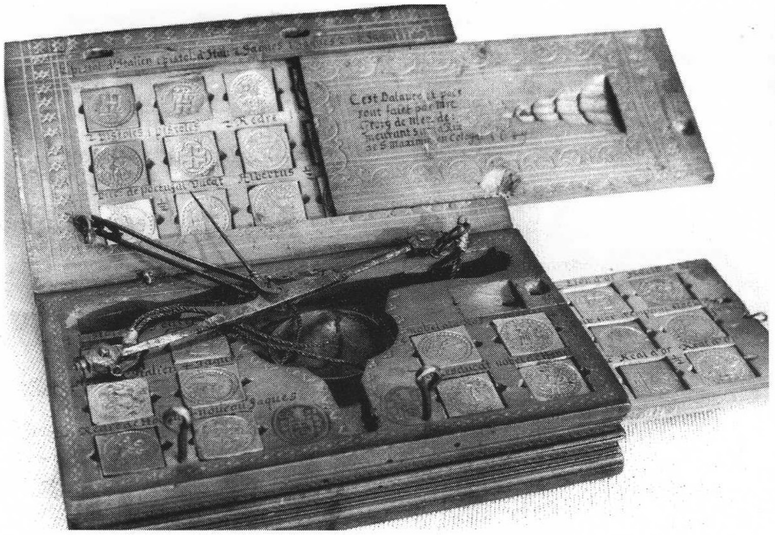


Fig. 8. ≻≻ J J Griffin & Sons 1899, showing the cord lift. The intention was to guide the downward movement of the beam by having two rods sliding through a fixed open box, to rest the beam on the two rods projecting from the rear bar, but the pendulous pointer and arc (out of sight below the beam) pull the beam out of alignment every time it descends, leaving the operator to reposition the centre bearing in its groove, disentangle the pointer from the arm holding the chart, and to check the position of the beam on the rods. There must exist other modifications done with the best intentions, but few could be more irritating than this one! The maker of this abomination is unknown, but the pedulous pointer is on some Continental precision balances, Fig. 31.



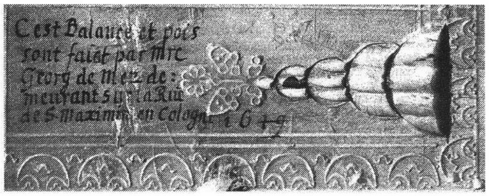


Fig. 9. ◄◄ & ▲▲ CFS made by Georg de Mez of Cologne, 1649. These money-changers boxes contained coin-weights for most of the coins circulating in the trading centres of Northern Europe, and the changers needed each weight to be as perfect as possible. Individual holes prevented abrasion, but the weights fitted in the holes so tightly that a spike was needed to lever the weight out! The spike had the additional function of piercing the drawer below, and the sliding lid above, so that neither could be lost.

them just big enough to hold pans, beam or weights, called by ISASC Cut-From-Solid or CFS. See Fig. 9. As the boxes were quite substantial, there was enough wood to carve decorative patterns on the highest quality ones.

Boxes could be made from flat sheets of wood with two-sided pens in front corners for the weights, called a Made-Up Box, or MUB. See Fig. 10. Punched patterns on the inside and outside of the lid help to date CFSs and MUBs

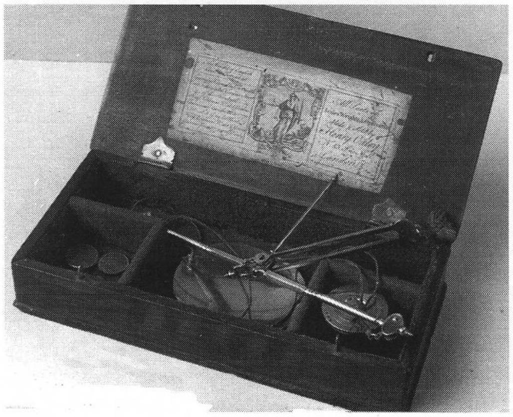
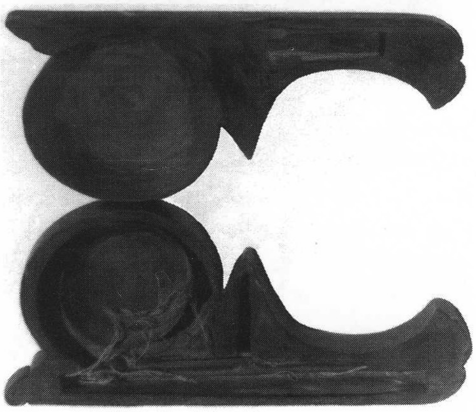


Fig. 10. ◄◄ MUB by Henry Oxley of 83, Snow Hill, London, (working 1761-93.) Exceptionally large MUB, to take bullion/coin scales with nesting Troy weights and coin weights.

Fig. 11. ►► Indian Ocean coin scales in sculpted box. The author has never seen weights in a box of this type. The box was shut by a band frequently lost. Were the weights then lost?



Shaped, curved boxes were used round the Indian Ocean, lovely boxes resembling snails , sometimes dyed red and highly polished. See Fig. 11. In Ireland the mahogany boxes were curved along their front edge so that a new collector might think the box contained a necklace.

Metal boxes took up slightly less room in the pocket, and could look magnificent. Brass was used occasionally, japanned tin or painted tin sometimes, aluminium or zinc rarely, or German silver (a brass alloy). Metal had one disadvantage, in that it abraded the contents, so padding was required, but the solution was beautiful, pink pads of silk, rich green woollen baize or silk brocade stuck to the insides.

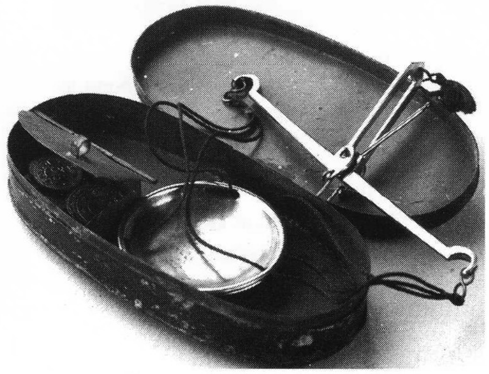
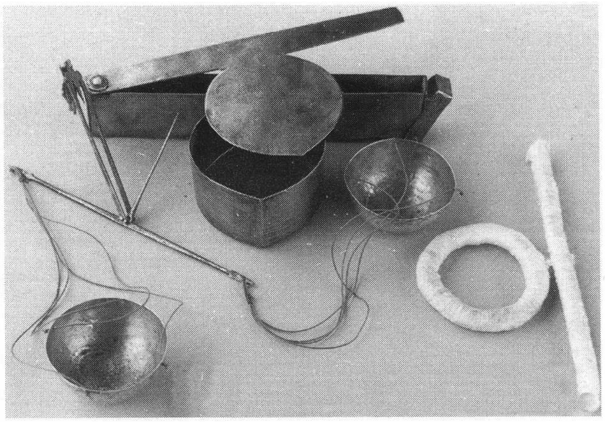


Fig. 12. ◄◄ Zinc case for mid-19th century UK apothecary scales, painted chocolate brown with gold & black floral border. Inside painted bright orange. Lidded locker for weights of 2, 1 & $^{1}/_{2}$ drachm, 2, 1 & $^{1}/_{2}$ scruple and 6, 5 and 3 grains. This cheap case had no padding to protect the contents from abrasion but it was intended to live on a shelf with medicines, not in the pocket.

Fig. 13. ➤➤ Brass case for pearl scales from Bahrain, 19th century. The swinging lid fits so closely that it cannot be padded, so the padding is separate, a cotton roll bound with thread. The right-hand end of the box is hinged at the bottom, so that it can be closed over the lid, holding it securely.



Leather over wood or plywood was used on better-quality boxes, red morocco leather, Fig. 15, ordinary black leather impressed with gilt patterns, shagreen (tanned shark-skin) either black and knobbly as in Fig. 14, or polished to give a finish resembling green mosiac. Leather pouches were used to protect spring balances or to hold all the weights (hence the heavy wear on Burmese and Akan weights).

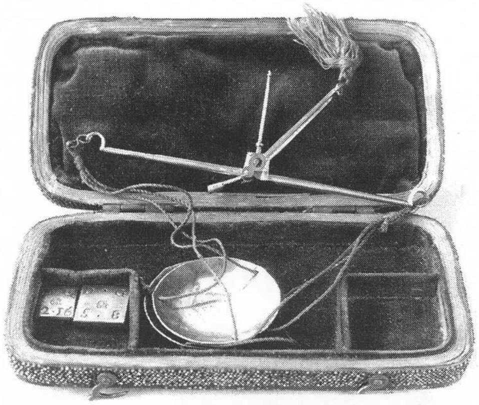
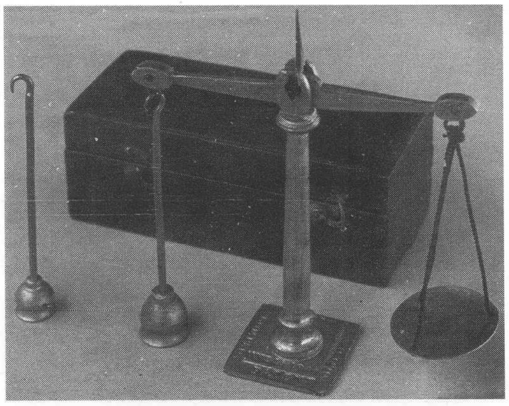


Fig. 14. ◄◄ Plywood case covered with black shagreen. Made in London. The velvet is machine cut, a method of manufacturing only developed at the beginning of the 19th century. The knobbly shagreen is very hard-wearing, but the cases were prone to warping if they got damp.

Fig. 15. ▼▼ Morocco red leather over wood. Lined with bottle green machine-cut velvet. This tiny box of sovereign scales was probably given away when a huge Olmstead Stove was bought to heat a hall or Church.



At the cheapest end of the market, boxes were made from card or paper. They were adequate for a short time, but usually had to be thrown away. See Fig. 16. Paper was a better protection when combined with glue to form papier mâché, forming a hard shiny case modelled to fit the scales. Papier mâché was fashionable from about 1760 until about 1780, and has not been utilised much since then.

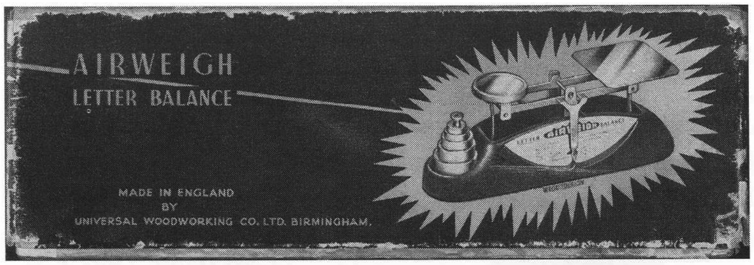


Fig. 16. ▲▲ Thin card box in which the Airweigh roberval scale was bought in 1956. It supplies the name and address of the maker, and says *a boon to any office*, implying that this was intended for office use not home use. Collectors value this ephemeral material.

Some boxes had a hole in them so that the box formed the support for a pillar. Pocket diamond balances, simple scientific balances, bullion balances, chondrometers and various other travelling balances had such a box. See Fig. 17.

Glass cases served a double purpose. They protected the balance and

Fig. 17. ▼▼ Box with a fitting for a pillar. Used by an American money-changer 1900-25. Machine-made comb-joints. Ring & hole ends were rarely used after about 1600 AD, but the Triumph Scale Co used them. An adjusting knob could be moved along either hole in the beam. Pennyweights & Troy weights supplied.

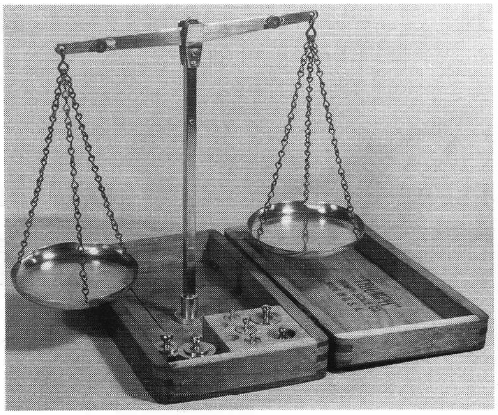
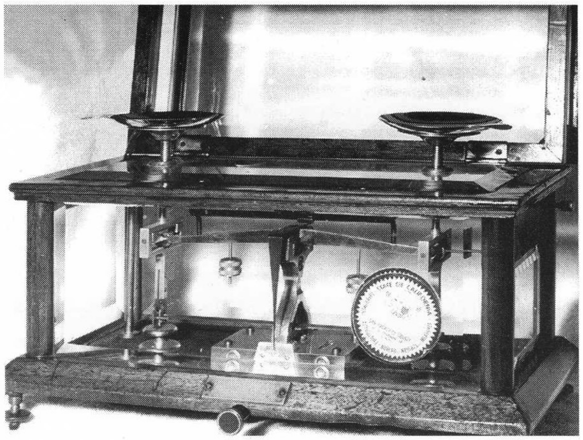


Fig. 18. ➤➤ The heavy plate glass is bevelled nicely on this charming Torsion Balance. The user needs to see where the rider poise is placed on the bar. The white disc on the front glass is the verification sticker applied in the State of California.



let in light so that the user could observe. Rectangular cases sometimes had thick plate glass with bevelled edges, which looks decorative but does not give a clear view of the whole scales. Some assay balances had glass cases that folded up and were carried separately, so that they could be erected in the field to cut out draughts and currents of hot air. The most sophisticated glass cases were domes intended to take the pressure of air being vacuumed out of the dome, as over the Sartorius 1953 Vacuum Balance.

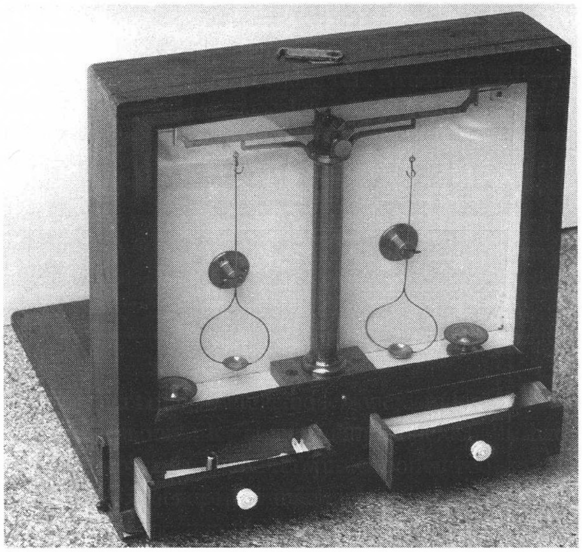
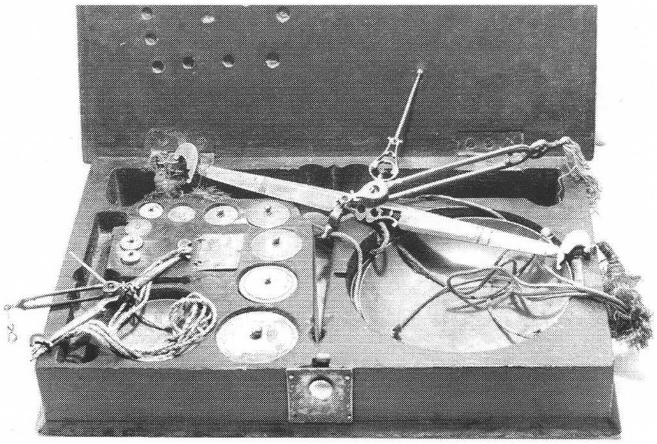


Fig. 19. ≺≺ This carrying case has a wooden front board that is removed during use, and used as a base plate. The minute pan-holders hold the true pans (skiffs) inside them when the skiff has been loaded with a button of metal to be assayed.

Fig. 20. ⋎⋎ "Mother and baby" coin scales from the Persian/Afghan border. Note the superb metalwork on the beams.



A particularly charming set-up is colloquially called a "mother and baby". The box contains two scales, one large and robust for heavier weighing, and one fine scale for lighter weighing. The Portuguese had pillars $1^{1}/_{2}$ metres high, suited to a big brass beam, and put a

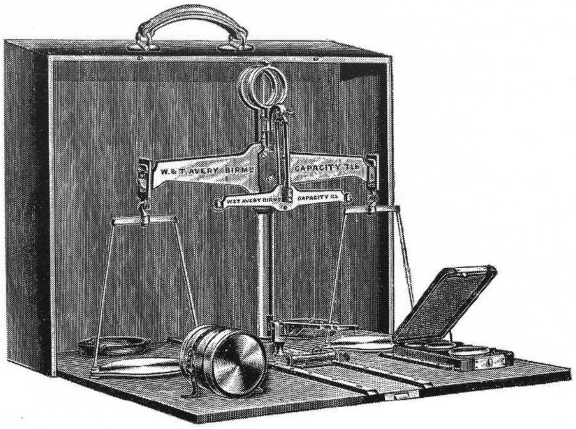
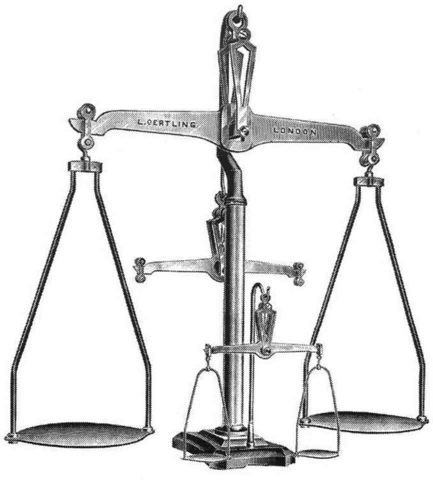


Fig. 21 ➤➤ Inspectors' set of 3 balances by Oertling, 1909. 28ins beam to carry 56lb, 16ins beam 7lb, and 10ins beam to carry 1lb. After the 1904 Act, they were packed in individual cases.

Fig. 22. ≺≺ Inspectors' set by Avery Ltd, 1897. Before the 1904 Act, they were carried together in one case.



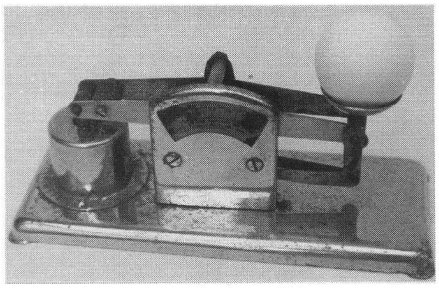


Fig. 23. ◄◄ The weights are enclosed in the drum on the left. The chart indicates the category of this egg, ie, 12 such eggs will weigh 18oz, or perhaps 12 such eggs will weigh 30oz. Kalhert Mfg Co, Minneapolis.

hook on the pillar for a little beam. The Persians made superlative cut-steel beams stored in crude, black-stained boxes, with badly-made hexagonal ring- or knobbed-weights. Fig. 20. Inspectors' outdoor sets sometimes had a mother and baby, but they surely used a more professional term to describe them! Figs. 21 & 22.

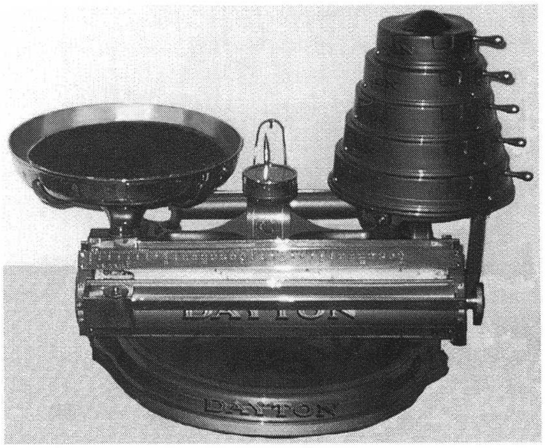


Fig. 24. ▲▲ The weights are dropped individually by pulling each lever towards the front. The rolling computing chart along the front is not part of the weighing mechanism, but the "side bar" along the front indicates the ounces. The base is circular because the whole scales can be swivelled round to face the user. Dayton Scale Co.

Weights

Loose weights will be dealt with in a future Beginners' Guide, but equal-arm beams sometimes have loose weights (not poises) approximately attached, raised or lowered by some mechanism. The visible mechanisms are fascinating, but occasionally the mechanism is enclosed, and then the only fun is to be had from listening to the regular clunks!

When a load depresses one arm, the other arm rises, and can collect weights as it rises, until equilibrium is reached. Interchangeable weights may be hooked onto the end of the beam. Fig. 15. If the weights are enclosed, a pointer and chart are needed to indicate the weight, Fig. 23, but some designs have exposed weights and the user must add together the total of weights raised. Fig. 25.

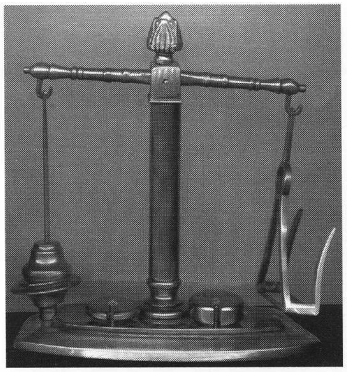


Fig. 25. ▲▲ The captive weight is 1/2oz, the small weight is another 1/2oz, and the larger weight is 1oz, but marked 4P, (four postages used in Britain 1840-1871), as that is what the three weights together indicate. The pillar is a replacement.

Weights can be applied from outside the case of a precision balance by a rack of arms each used to drop one weight onto the hanger. Usually the hanger takes the weights on individual rods tied across the hanger, but many ingenious variations exist.

Just as much fun are the "beehive" weights that are dropped onto a roberval scale with individual levers Fig. 24.

A poise, (ie, a mass that was not a unit of measurement, but that could be read on graduated marks to represent a unit of weight) was used along the beam of many equal-arm scales, giving a simple read-out of the smallest units. Say the scale used loose weights from 7lb down to 1oz. The poise might read out 24 grains down to 1 grain. Strictly, this poise is turning the equal-arm into a steelyard, but the main weights are full weight, balancing the load, so the subsidiary poise is ignored for purposes of classification. Fig. 26.

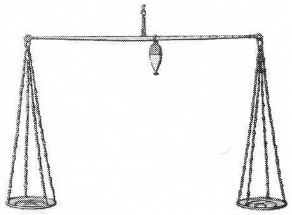
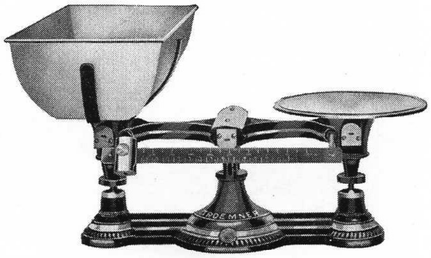


Fig. 26. ▲▲ The Romans c.200AD used a rider poise to indicate the smallest units on their trade scales.

Fig. 27. ►► Henry Troemner baby scale, 1937. *Made on the even-balance principle, with full agate bearings. The only accurate method for exact weighing.... Scales are furnished with side beam on front, graduated at the top row in metric system, from 5 grams to 500 grams, by five-gram notches, and on the bottom row in the avoirdupois system from 1/8oz to 16oz (1 pound) by 1/8oz notches. Sliding weight on side beam, with set screw to secure it where placed. The use of the side beam makes it unnecessary to use weights below 500 grams, or one pound. Small weights get lost.... One set of weights, either in the metric or avoirdupois system, furnished with each scale, 5k -1 kilo, or 10lb - 1lb.*



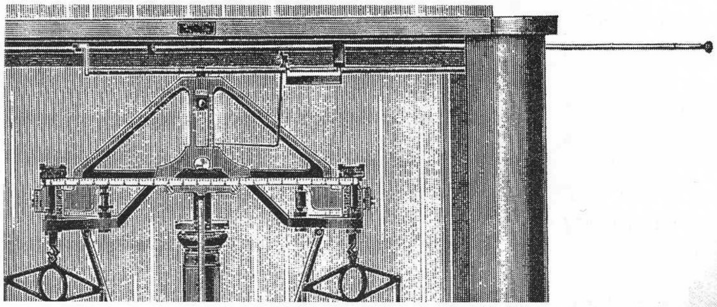


Fig. 28. ≺≺ The wire riders are so small that they must be lifted on and off the bar using a fine pointed rod that engages the tiny loop in the top of the rider. The extension of the rod is visible on the right-hand side of the case. Sartorius-Werke, 1922.

The smallest poises are called riders, and are mere twists of wire that are applied to the beam itself, if the beam is straight along its top edge, or to a fine bar along the front, if the beam is curved or triangular along its top edge. See Fig. 28.

A way of indicating the small variations in weight was the use of an added graduated arc or graticule behind the pointer. The main weighing was done with loose weights in the pan, then the arc was looked at, and the finest graduations read off the arc, without applying tiny weights. This method was used to indicate the loss of gold from Hungarian Ducats. Fig. 29.

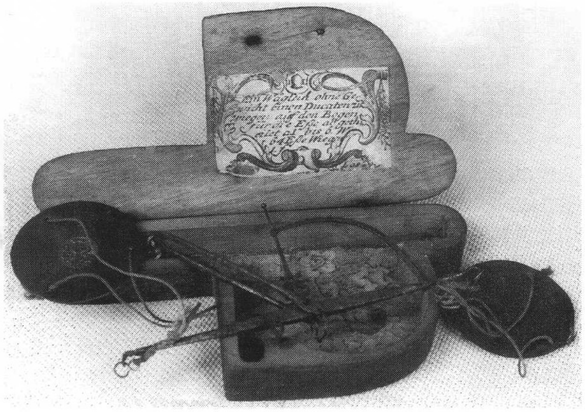


Fig. 29. ⋏⋏ The arc between the pointer and the right arm is graduated to indicate the number of grains of gold lost from the Hungarian ducat coin being weighed in the left pan. The right pan is pre-loaded to the correct weight. Made by Johann Loss of Nuremberg, working 1726-1749.

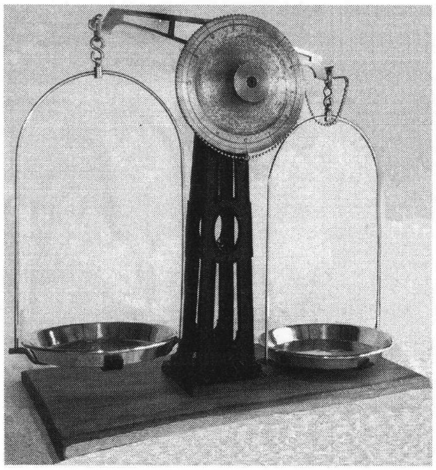


Fig. 30. ≺≺ The chain disc on this apothecary is exceptionally large. The chain is attached to the disc and to the right end of the right arm. German.

During the mid-20th century the small weights in chemical samples have been assessed by merely winding or sliding a chain out, so that more weight was applied to one end of the beam than to the other end. Many precision balances were made with a drum wrapped round with chain, and Baird & Tatlock even supplied a chain drum attachment that the user could fit to his balance. The chain was attached to the beam, so had a damping effect that speeded up simple weighings. A rare example of an apothecary scale with a chain was made in Germany. Fig. 30.

Damping

The reason for damping was to speed up the weighing process. If the pointer was allowed to swing until it came to rest, the user spent a LOT of time drinking cups of coffee or writing shopping lists. He could get to the answer more quickly by seeing how far to each side of equilibrium the pointer swung, and once it was the same on each side, assume that he'd got the correct weights on, without waiting for a motionless pointer. He could even watch the pointer swing to one side only, and divide the graduations by two, and say that the load was that much below or above equilibrium. But damping was better for the less-experienced user. By bringing the pointer to a stop rapidly, he could be sure of the answer.

Many users were very suspicious of dampers when they first appeared in the late 19th century. They assumed that the damper falsified the answer. After many tests, this was found to be a fallacy. Dampers only stopped the swing quickly.

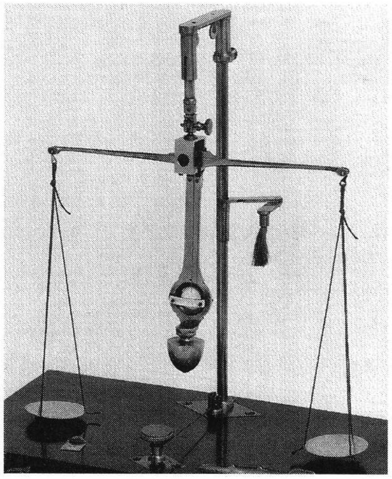


Fig. 31. ➢➢ Brush on an arm attached to the pillar. Also has a pendulous pointer exactly like the one on Fig. 8. Has fittings in the drawer to store all parts of the scale and pillar. Also has cord lift. Courtesy G Höxtermann

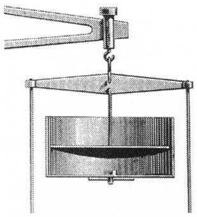


Fig. 32. ◁◁ The vane is inside the drum which is attached independently to the pillar. Air seeps slowly round the edge of the vane. Design by F Arzberger of Vienna, 1875.

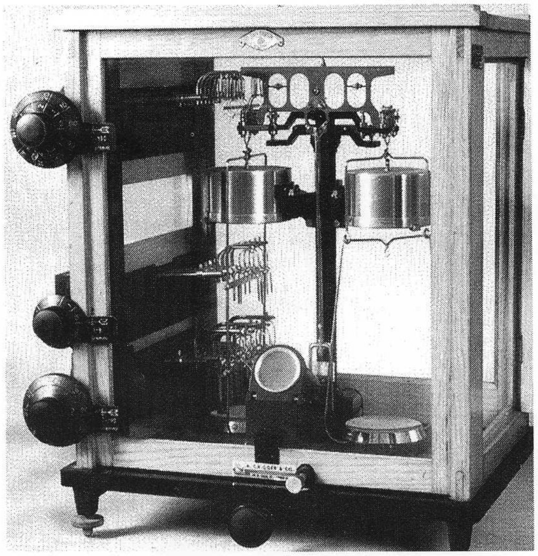


Fig. 33. ◁◁ The air damping drums at the top of each hanger, with the black arms for the vanes attached to the pillar. Each weight is applied by a separate arm, each row of arms being moved up or down by rotating the dials on the left. The lens points towards the bottom of the pillar, to aid observation of the tiny movements of the pointer in front of the graticule. Sartorius-Werke, sold by Galileo in Milan.

The simplest damper was a long-bristled brush that was placed where the pointer swept through the end of the bristles, and was quickly slowed down. Fig. 31.

A more elaborate system was a vane attached to the beam. The vane was submerged in a pot of oil or silicone, with only a small hole permitting the liquid through the vane. This slowed the beam down very rapidly, and was frequently used in simple chemical balances and person-weighing scales. The hole in the vane could be made bigger or smaller by the repairman, by moving a shutter across the hole. It was suitably rugged, as long as the scale was kept upright, and the oil not allowed to leak out.

For more subtle slowing down, a magnetically-inert (copper or aluminium) metal pointer could swing between two magnets. OHaus used this system frequently on their steelyards, and Sartorius used it on his equal-arm precision balances. It did not look pretty, but it worked.

The most subtle damping was done with a vane fitted to each end of the beam, each vane fitting reasonably tightly inside a circular drum. Because the air in the drum could only leak round the edges of the vane slowly, the vanes broke the speed of the swinging beam. These air-damping drums are clearly visible on many fine precision balances, usually near the top of the hangers, but sometimes on top of the case, or under the pans. Fig. 33.

Viewing

Users have a detrimental effect on scales. Users are warm, and create currents of hot air that rise up, affecting the length of an arm or causing a pan to rise. When precision weighing is being done and several weighings are taken to give reproducible results, the graticule may be viewed through a lens, with the user a little way from the case, or with a telescope, and the user a long way from the case.

In extreme cases, the user did not even want to open the case, so a mechanism was built into the base to move the load and its pan from one side to the other without opening the door. Only National Laboratories need such a mechanism, and Rueprecht supplied the few built in 1878.

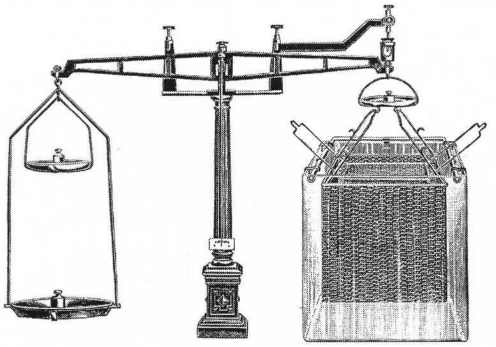


Fig. 34. △△ The mass of the plates is balanced with the weight on the bottom pan. The weight of plating to be added is put on the top pan. When enough plating has accumulated, the load drops, and the current stops flowing through the liquid.

Accessories for special trades

An infinite variety of attachments were made to suit craftsmen and tradesmen. Many scale-makers supplied fittings on demand. For example, J J Griffin, 1913, show an electroplaters' balance, Fig. 34, and H Troemner, 1926, shows a cream scale for 12 bottles, Fig. 35.

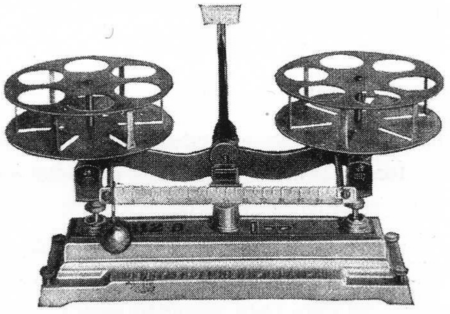


Fig. 35. △△ Cream testing scale for 12 bottles. The bottles are tared first, using the round poise on the side beam, then the small poise is moved to indicate 9 or 18 gram divisions. H Troemner, 1926.

US Patents 1837-1865

Text by R HENDRICKS WILLARD

Captions by D CRAWFORTH-HITCHINS

To the collector, a patent reveals the history and technology of his scale: who invented it and how it works. To society it is a legal document that allows individuals to profit from their inventions for a specified time by sharing the information (for a price) rather than keeping it to themselves. At the end of that period, inventions enter the public domain. Without such an incentive, the ideas would benefit only the inventor and possibly his heirs, and civilization could not progress.

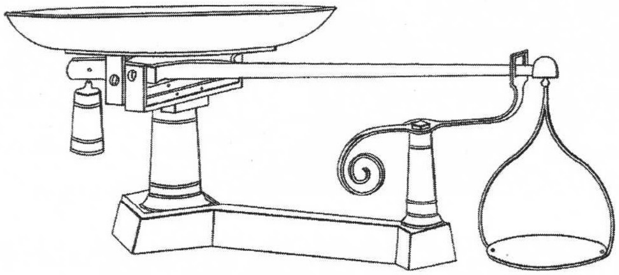


Fig. 1. ◄◄ No. 129 of Feb 16, 1837. Morison took out two patents, one for a table-height equal-arm counter scale, with schickert's principle masses below the pans, and this contracting beam for the convenience of druggists and grocers in weighing bottles, kegs, boxes and bulky articles generally. The pan is held by a half-roberval linkage (his patentable feature), and the small poise (under the pan) balances the mass of the little pan. The beam is in equilibrium before use. The strange feature is that the beam is not graduated. The user must use weights in the right-hand pan, and multiply up by the ratio used. If the hanging-pan is sixteen times as far from the fulcrum as is the top-pan, then 1oz in the hanging pan balances 16oz (1lb) in the top pan, but Morison does not point out that by reversing the placing of the load and the weights, the user could get accurate readings for very small loads. Morison does suggest a graduated beam and poises for "very large articles".

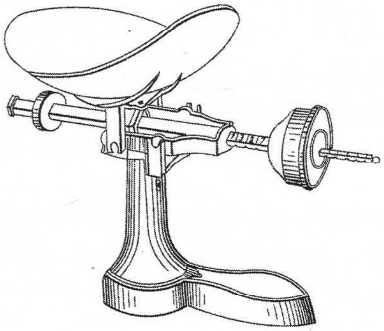


Fig. 2. ▼▼ No. 1,131 of Apr 20, 1839. Ball too uses a half-roberval linkage, but with two extending tubes, one graduated in pounds and a smaller one graduated in ounces, the object of his patent. The smaller disc at the rear of the beam tares the pan. The larger disc is fixed rigidly to the pounds-tube and provides a mass that enables Ball to make a short (10ins) tube to indicate many pounds.

In Part 1 of this series,[1] we discussed the so-called X Patents, which were issued from July 4, 1790 to July 4, 1836. Very few collectors have examples of American-made scales produced that early. Those patents varied considerably in quality according to the legislation in force at the time of issue.

The Act of July 4, 1790, required the applicants to submit drawings, specifications, and an exact model to Congress. A Patent Board composed of the Secretary of State, Secretary of War, and Attorney General determined whether an invention was sufficiently useful and important to merit granting a patent. It was up to them to establish the rules of patent practice. A mere change of material of construction for a known device or a mere change in the form of an old device disqualified the application. They required that any known machine should remain available for any use that it might be put to. Although well qualified to make such judgments, these busy men found it

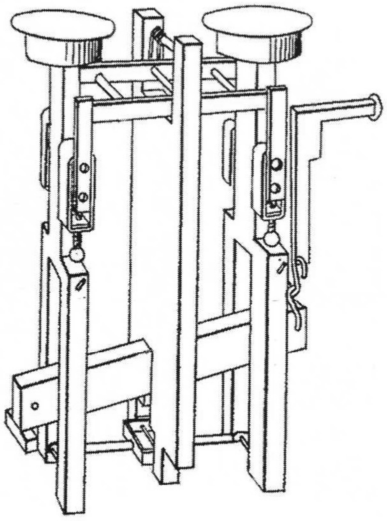


Fig. 3. ►► No. 1410 of Nov 16, 1839, by White, the first American full roberval design, but entirely made out of wood. The proportions are somewhat strange, but it might work. The handle on the right lifts the whole mechanism up 2ins, free of the counter, for use..

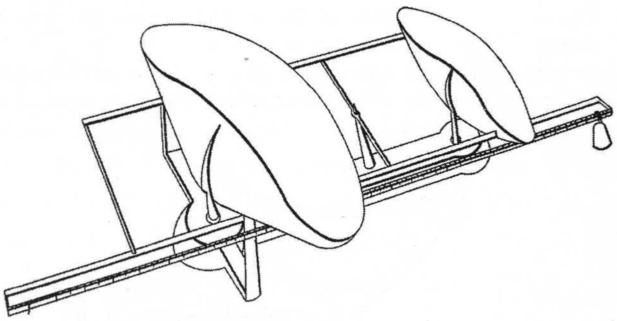
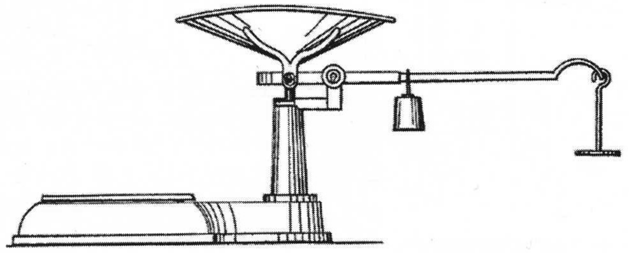


Fig. 4. ≺≺ No. 2,397 of Dec 23, 1841. Dole uses a modified roberval linkage, with the top frame attached to a steelyard and the bottom linkage attached to the spiders holding the pans. The load in the large pan is read off in pounds, and a load in the small pan is read off in ounces. This feature is the object of his patent, unfortunately, as if he'd taken out a broader protection for his steelyard it would have fended off Fairbanks in 1849. Parker took out patent 3,112 of May 26, 1843 for the same system, but could patent only the top frame.

Fig. 5. ➢➢ No. 3,111 of May 26, 1843. The first known patent for a Union scale, the object of Morrill's patent, and actually called that in the patent. He makes no reference to any earlier patent. Gibbs patented another Union scale in 1846, patenting a swivelling steelyard. Sanborn also improved the Union scale, redesigning the levers under the platform in 1855. He assigned the patent to Fairbanks.



necessary to spend many evenings at home performing this work. Finally, they asked to be relieved of the extra responsibility, and new legislation was enacted.

The Act of Feb. 21, 1793 went from the extreme of rigid examination to no examination at all! Applications were to be submitted to the State Department, which was not allowed to refuse any patent as long as the proper forms, affidavits, and model were submitted. There was no requirement that the applicant claim specific features of hs device as the novel part of his invention.[2] The department had no authority to reject patents even if copied without modification from patents previously issued to others! Arguments about patentability were to be settled by the courts. Needless to say, this lax system led to many abuses.[3]

In this issue, we present patents issued in the three decades following two nearly concurrent events: the passage of the Act of July 4, 1836, and the disastrous fire that destroyed the Patent Office and all its contents in December of that year.

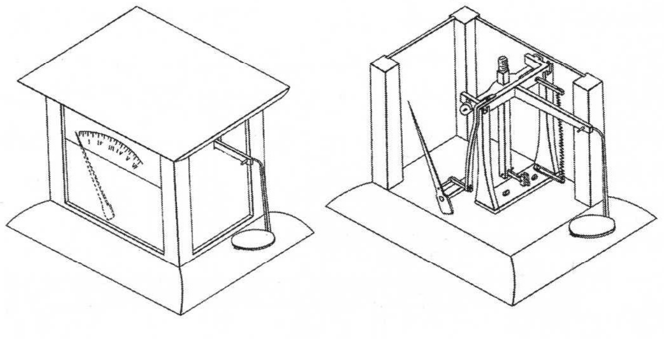
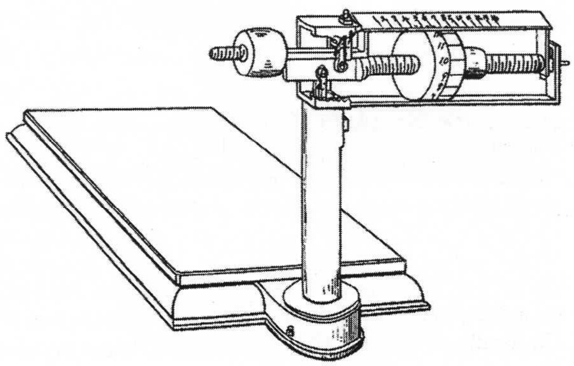
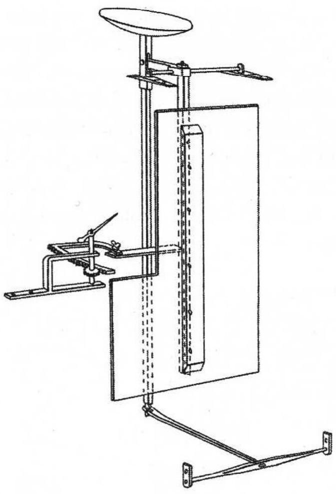


Fig. 6. ≺≺ No. 3,396 of Jan 6, 1844. Moore uses a half-roberval linkage for stability, a steelyard with proportional weights to balance the major part of the load, and a spring and dial to indicate the aliquot parts, usually ounces. He does not specify how the spring is prevented from being strained by overloading.

Fig. 7. ➢➢ No. 5813 of Sep 26. 1848. Underwood & Stevens patented their design of levers under the platform and the micrometer (the first known in USA) that gives very fine divisions of the graduations. The scale is of industrial size for weighing hay or for railroads. Given the language of the patent, Stevens was a manufacturer.





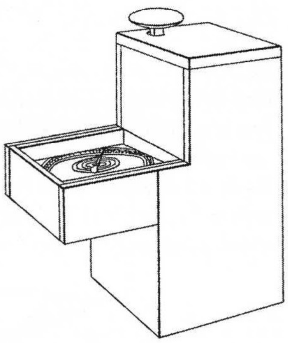


Fig. 8. ⮜⮜ No. 5,825 of Oct 3, 1848. Sampson was a successful manufacturer, patenting many large scales. This counter scale patent is for a bent-lever with a hanging weight as the resistant. By 1848, a succession of patents included a half-roberval linkage.

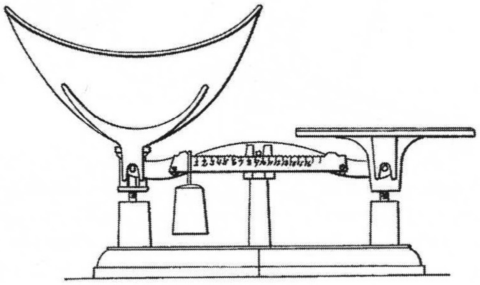


Fig. 9. ⮞⮞ No. 6,169 of Mar 13, 1849. Fairbanks shows the earliest-known American full roberval scale of familiar design. The object of the patent is the steelyard along the front, used for small divisions, which apparently is not the same as 2,397!

No. 9,844 of July 12, 1853 and 9,997 of Sep 6, 1853 indicate a spurt of worry about counterfeiting in 1853. See Newman and Mallis' book *US Coin Scales and CCDs* for details.[7]

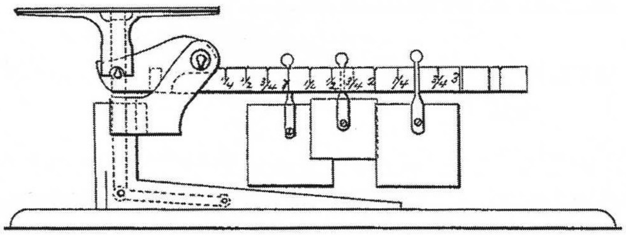


Fig. 10. ⮜⮜ No. 14,198 of Feb 5, 1856 is yet another variation on the counter-steelyard. Mills & Bissell show the first known US divided beam, the object of the patent. The steelyard is divided into three, with three poises captive on the beams.

Issued sixty years to the day after the original Declaration of Independence, this act has been described by some historians as the most important thing to happen in this country between the War of 1812 and the Civil War. The first Declaration led to our political independence from England. The second led, just as inexorably, to our industrial independence from Europe.[4]

A shortage of labor was the one dominating characteristic of the American economy that set it apart from the British and European economies. Even in the eighteenth century, American entrepreneurs had to look more intensively for labor-saving machinery than their European counterparts. The French invented the principle of interchangeable machine-made parts, but the Americans, including E & T Fairbanks, were the ones who brought it to commercial profitability. By providing a workable system that allowed men and women from all classes to profit from their inventions, that piece of legislation harnessed the ingenuity of virtually the entire population. By 1850 the habit of thinking in terms of machinery was ingrained, a fact that was to send American productivity per individual worker soaring above that in Europe.[5]

Fig. 11. ⮞⮞ No. 14,361 of Mar 4, 1856. Kelly wanted an all-singing, all-dancing counter steelyard. The rear, smaller poise tares the pan. The larger poise is a gross tare. The main steelyard has a screw-out tube that balances the load. The tube operates two subsidiary pointers, one alongside the tube to indicate pounds, and the circular dial mounted horizontally on top of the tube to indicate ounces. A third pointer moves along graduations behind the pan to indicate fractional parts of a pound, (why a user would need this facility is not explained).

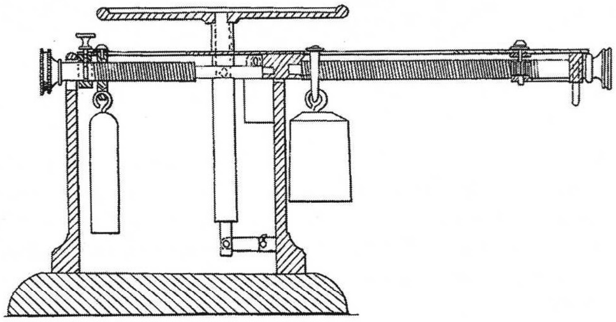
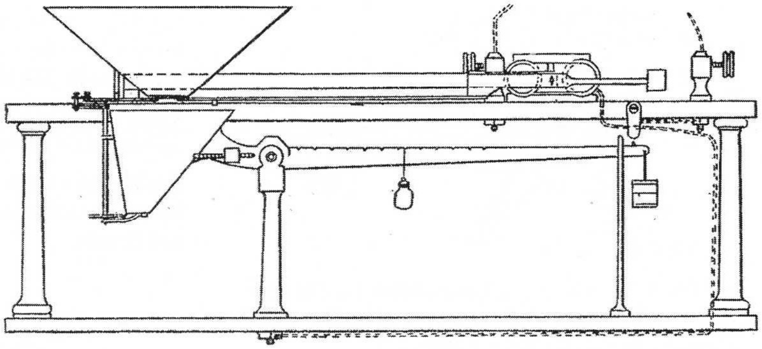
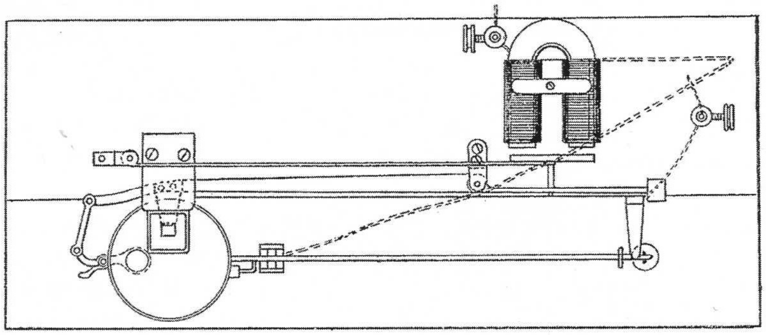


Fig. 12. ➢➢ No. 14,733 of Apr 22, 1856. Not collectible because of its huge size. Phillips' Electro-Magnetic Grain-Scale was for factory use, but included here because it is the first scale-patent using electricity.

No. 16,390 of Jan 13, 1857, a well-known counterfeit coin detector (CCD) by H Maranville. See EQM 13 and reference 7.



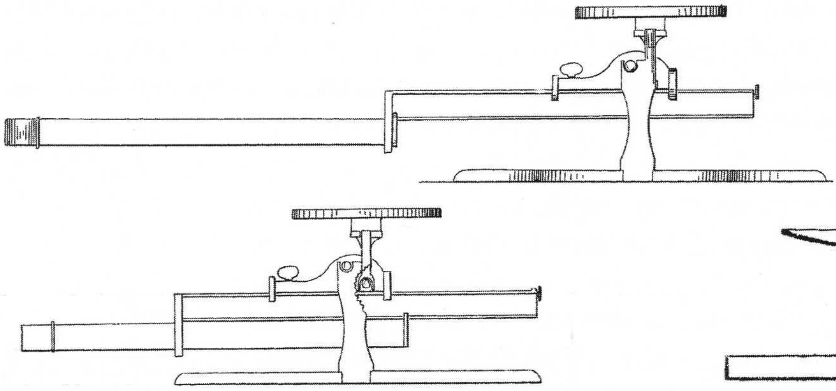


Note the gap in the numbering between the previous scale and this one. A great number of huge scales were patented during this period, mostly for weighing grain. Either grain meters were inefficient, or the demand for them was so great that many entrepreneurs saw an opportunity.

This surge of creativity is the theme of a handsome volume first published in connection with America's Centennial celebration and reprinted for the Bicentennial. In their preface, the publishers state that their purpose is *to herald to the world and perpetuate to futurity, the accomplishments which by skill, energy, enterprise, and indomitable perseverance a free and enlightened people have accomplished.* Lavishly illustrated with copper-plate steel engravings, the book illustrates the many industries for which scales were needed. Scale-makers Thos Morton, John S Chatillon & Sons, and Fairbanks Scale Manufactory are among the firms included.[6]

Until recently, locating the patent for a given scale has required a visit to the US Patent Office or one of its branch depositories,

Fig. 13a & b. ➢➢ No. 23,700 of Apr 19, 1859. Peirce (sic) patented yet another counter steelyard with sliding tubes. The lower tube is pulled out and read directly. If the load is too heavy, the upper tube is released and pulled out too, and readings taken on the upper surface of that tube, then the amounts added together. Platt & Rosencrans were able to patent another similar scale, no. 33,403 in 1861.



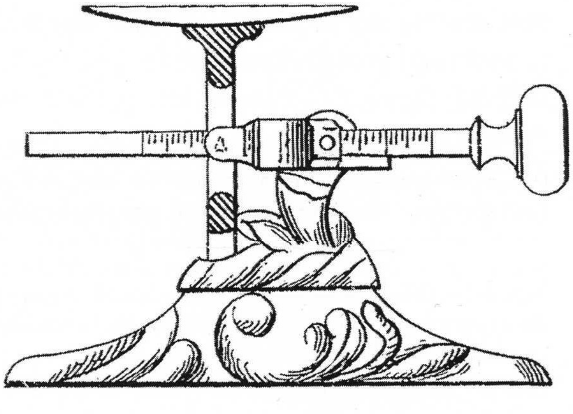


Fig. 14. ➢➢ No. 24,669 of July 5, 1859. Strange's patent was actually manufactured, a very small postal scale with a pretty red cast-iron base. See EQM 2371. The patent has the bismar beam graduated with several units so that by turning the beam when balanced, postal rates or weight can be ascertained.

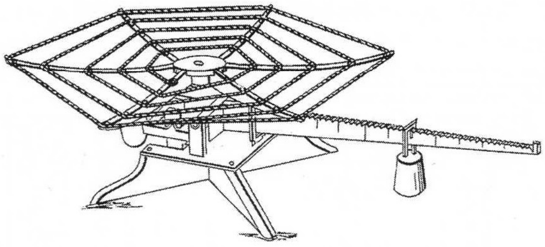
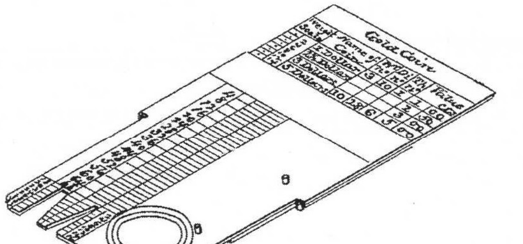


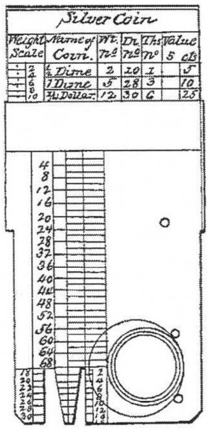
Fig. 14. ≺≺ No. 25,203 of Aug 23, 1859. This steelyard was designed for use in a warehouse, so must be larger than it appears, and could be converted to weigh bulky bundles such as hay by enlarging the platform.

Three weeks later Turnbull patented his famous half-roberval and spring counter scale (to be discussed in a future EQM), No. 25,473.

Fairbanks took out No. 26,026 of Nov 8, 1859 for their postal scale held vertical by Schickert's principle, see EQM 427. They patented it in USA and Britain.

Fig. 15a & b. ≻≻ No. 27,140 of Feb 14, 1860 by H Maranville, EQM 820. It checked gold on one side and silver on the reverse side.





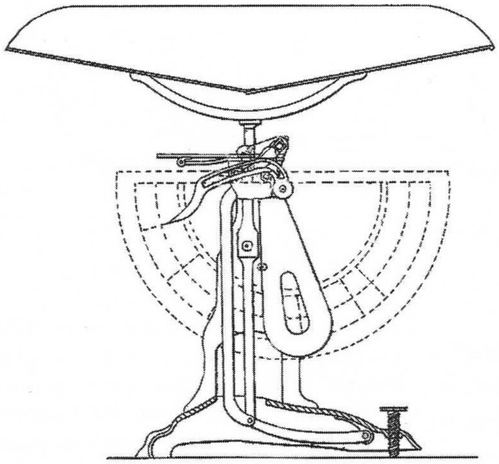


Fig. 16. ≺≺ No. 27,683 of Apr 3, 1860. This pendulum scale is normal to our eyes but was completely novel when H N & J C Bills invented it.

No. 28,212 of May 8, 1860, an ingenious oval spring scale by Squyer is shown in EQM 1906.

No. 35,125 of April 29, 1862 is for a spring balance with an exposed helical spring, a feature that seems only to have been used in USA.

or a laborious examination of the publication: *Subject Matter Index of Patents for Inventions Issued by the United States Patent Office from 1790 to 1873, Inclusive*, by M D Leggett, Commissioner of Patents. With the advent of the Internet, the US Patent and Trademark Office posted copies of all the patents issued since 1976 on their website. Not much help for a collector of *antique* scales! However, the website has now been expanded to include about one-fourth of the 10,000-plus original patents issued from 1790-1836, destroyed by fire, and reconstructed from other records, as well as every patent issued by the United States from late 1836 to the present day.

The thirty years between the Patent Office fire and the end of the Civil War saw an explosion of inventions designed to improve the productivity of farmers and provide facilities for getting their crops to distant markets. About half of the 235 scale-related patents issued during that time pertain to railroads, canals, and grain meters. Such scales are much too large for our purposes. Table 1 lists the patents for the 113 scales that might be considered collectible. We hope you will use this table in two ways: to locate the patents

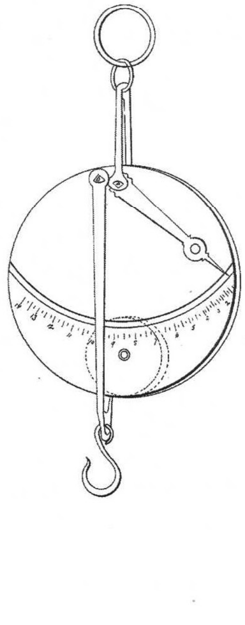


Fig. 17. ≻≻ No. 35,155 of May 6, 1862 is a standard pendulum scale, very reminiscent of the aluminium scale made by Buddy Mfg Co, St. Louis, MO.

No. 35,834 by Painter is shown in Newman & Mallis' book *US Coin Scales and CCDs*.[7]

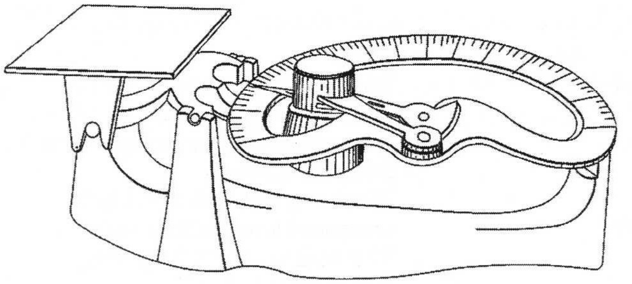


Fig. 18. ≺≺ No. 39,145 of July 7, 1863 by S Harris is for a poise that moves through an arc on a steelyard. The principle is the same as used on the roberval scale by Anderson Scale Co, EQM 2227-30.

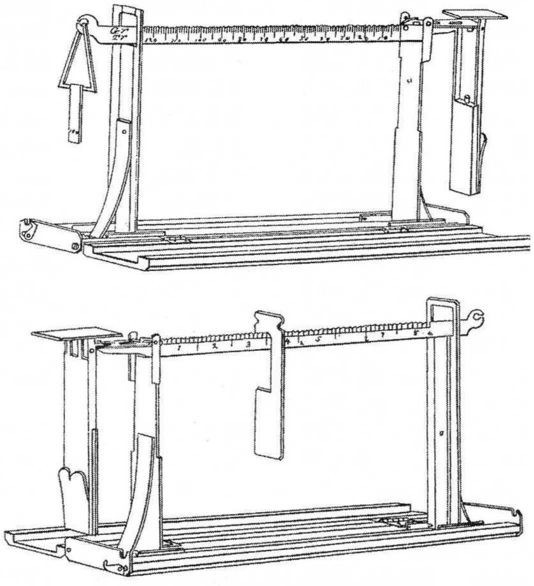


Fig. 19b. ➢➢ No. 50,254, of Oct 3, 1865 by H Maranville is exceptionally interesting, being a ruler that unfolds to become a steelyard for ascertaining postage-rates and the true weight of coins, weighing in drams and ounces avoirdupois, grains, ounces, pounds, scruples and drams in Troy and apothecary weight. The pan was held horizontal by Schickert's principle. Was it ever made?

for scales in your collection, and to browse through for the sheer enjoyment of seeing the original designs proposed by inventors so early in our country's history. The writer will be happy to email this table in Excel to any requesters who want to format it by inventor, residence, or type of mechanism, and to provide hard copies in any of those formats to members who do not have email capabilities.

With thanks to Norman Cima for entering the scrambled citations in the Subject Index in an Excel file, to Steven Beare for sharing the list he obtained through a professional research service, and to Diana Crawforth-Hitchins for downloading and interpreting the scale-related patents on the USPTO website.

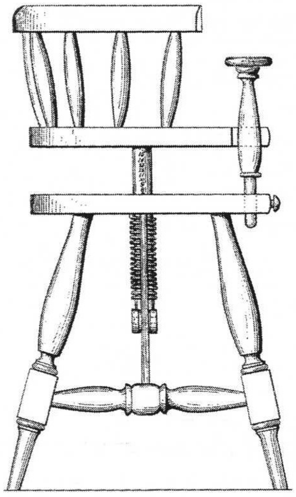


Fig. 20. ≺≺ No. 51,091 of Nov 21, 1865 by Shedd & Glockner for a child's chair on which the child was encouraged to bounce up and down, which can't have helped the accuracy of the scale element! Only one spring is visible in this view, but another spring was mounted on the far side of the seat.

No. 51,226 of Nov 28, 1865 by R Shaler is discussed on pages 2647-2649.

No. 51,357 of Dec 5, 1865 by J Sangster is shown on page 2671.

Notes & References

1. "X Marks the Patent", *Equilibrium*, 2637-2639.
2. This peculiar circumstance accounts for the puzzling features of Dearborn's patent 3089X as discussed in "First American Scale Patentee," *Equilibrium*, 2639-2643.
3. Dobyns, K W, *The Patent Office Pony, A History of the Early Patent Office*, Fredericksburgh VA, Sergeant Kirkland's Museum and Historical Society Inc, 1904; pgs 35, 36, 38, 45, 47, 70, 86, 87, 97.
4. Dobyns, pgs 101, 102.
5. Kelley, R, *The Shaping of the American Past*, Englewood Cliffs, NJ, Prentice-Hall, Inc, 1978, pgs 287-290.
6. Readers may enjoy examining this fascinating work, *Pictorial Album of American Industry 1876*. 1st edition New York, Asher & Adams and London, G Phillip & Son. Reprint 1976, New York, Rutledge Books.
7. Newman, E P, & Mallis, A G, *U.S. Coin Scales and Counterfeit Coin Detectors*, self-published, USA, 1999.

Patents sorted by date, (shop/warehouse platform scales and smaller). 1837-1865

NO.	DATE	INVENTOR	RESIDENCE	ASSIGNEE	TYPE
118	Feb 10, 1837	E & T Fairbanks	St Johnsbury, VT		Bearings under platform. See also Nos. 119, 120, 121, 122, 123, 124
129	Feb 16, 1837	B. Morison	Milton, PA		Counter steelyard for apothecary use
562	Jan 9, 1838	A H Free/Tree	Troy, NY		Steelyard in frame
641	Mar 17, 1838	B. Morison	Milton, PA		Arrestment for platform steelyard
899	Aug 30, 1838	J D Dale (maker)	Lansingburg, NY		Compound lever platform scale
1,048	Dec 31, 1838	R L McCollum	Rochester, NY		Ring bearings on platform scale
1,131	Apr 20, 1839	J Ball	Buffalo, NY		Tubular steelyard
1,410	Nov 16, 1839	G White	Louisville, KY		Arrestment for counter roberval
1,546	Apr 19, 1840	C Crain & E L Wemple	Madison, NY		Balance ball below steelyard
1,699	July 18, 1840	A Dole	Bangor, ME		Levers for platform scale
1,708	July 31, 1840	S E Winslow	Philadelphia, PA		High ratio fulcra for steelyard
1,942	Jan 23, 1841	M Robbins	Hollidaysburg, PA		Disc & cord lift arms of toy man
1,974	Feb 12, 1841	C E Dampier	Ware, UK		Circular pendulum scale
2,224	Aug 21, 1841	E Willemin	Leesburg, OH		Turn-over steelyd, 4 graduated sides
2,397	Dec 23, 1841	A Dole	Bangor, ME		Pound & ounce pans, counter steely'd
3,111	May 26, 1883	B. Morrill	Boscawen, NH		Union scale
3,112	May 26, 1843	E H Parker	Bucksport, ME		Sub-linkage for counter sc
3,396	Jan 6, 1844	G R Moore	Brattleboro, VT		$^1/_2$ steelyard & spring sc
3,752	Sep 20, 1844	J H & R K Bull	New York, NY		Spring platform scale with dashpot
4,757	Sep 12, 1846	J Gibbs	Newark, OH		Swing-round steelyard on platform sc
5,813	Sep 26, 1848	J Underwood & S F Stevens	Montpelier, VT	S F Stevens	Micrometer platform sc
5,825	Oct 3, 1848	E Sampson & C S Collier	Wethersfield, VT		Pendulous sc
6,169	Mar 13, 1849	T Fairbanks	St. Johnsbury, VT		Sliding bar on roberval counter sc
6,174	Mar 13, 1849	R Eastman	Concord, NH	M L Eastman	Wt-lifting counter sc $^1/_2$ roberval & steelyard
6,194	Mar 20, 1849	T & W Flint	Westford MA & Chelmsford, MA		Price-computing steelyard
6,852	Nov 6, 1849	E Sampson	Claremont, NH		Pend plat shop sc with reverse wg
6,895	Nov 20, 1849	T Fairbanks	St. Johnsbury, VT		Rubber shock absorbers
7,122	Feb 26,1850	S T McDougall	New York, NY		Linked steelyards
7,183	Mar 19, 1850	C Downer	Philadelphia, PA		Steelyard frame for store use
7,270	Apr 9, 1850	W P Pierce	St. Johnsbury, VT	E&T Fairbanks Co	Knives for steelyard
7,562	Aug 13, 1850	G Houston	Washington, DC		Ramps for steelyard
8,391	Sep 30, 1851	N B Livingston	Portland, IN		Steelyard on cart
8,942	May 11, 1852	R Newell	Lebanon, IN		Spring bal on platform sc
9,170	Aug 3, 1852	W P Goolman & W Holtzclaw Jr.	Springtown, IN		Extended steelyard for platform sc
9,635	Mar 29, 1853	B Fenn	Hartford, OH		Pendulum counter sc
9,844	July 12, 1853	H G Robinson	Schuylkill Haven, PA		Money box plus CCD
9,997	Sep 6, 1853	G B Smith	Baltimore, MD		CCD
10,256	Nov 22, 1853	S T McDougall	New York, NY		Lever design under platform
10,896	May 9, 1854	W S Reinert	Spring Garden, PA		Weighing and printing butter
11,729	Sep 26,1854	J F Keeler	Cleveland, OH		Spring platform sc, arrestment
12,246	Jan 16, 1855	J L McPherson	New Vienna, OH		Poise moving round rim of pan of counter sc
12,249	Jan 16, 1855	E P Beckwith	New London, CT		Price computing spring balance
12,698	Apr 10, 1855	D M Smyth	New York NY		Pend counter sc with 2 poise hangers
13,232	July 10, 1855	F Scheurer	New York, NY		2 equal arms under platf'm counter sc
13,331	July 24, 1855	A Sanborn	St. Johnsbury, VT	E&T Fairbanks Co	Union scale
13,840	Nov 27, 1855	J Allender	New London, CT		CCD

14,198	Feb 5, 1856	S S Mills & T Bissell	Charleston, SC		Triple beam counter scale
14,361	Mar 4, 1856	J Kelly	Sag Harbor, NY		Steelyard counter sc w/ moving dial
14,382	Mar 4, 1856	W Yost	Goshen, OH		Chondrometer with tare beam
14,702	Apr 15, 1856	R F Wolcott	Claremont, NH		Poise for steelyard platform sc
16,302	Dec 23, 1856	E Sampson	Vergennes, VT	Vergennes Scale Mfg. Co.	Micrometer poise on steelyard
16,390	Jan 13, 1857	H Maranville	Clinton, OH		CCD
17,252	May 12, 1857	O & Z W Avery	Bethany, PA		Rolling poise on steelyard counter sc
18,973	Dec 29, 1857	F J Herper	Newark, NJ		CCD
19,061	Jan 5, 1858	J Kelly	Sag Harbor, NY	J Kelly & J Sherry	Levers under platform
19,985	Apr 20, 1858	C H Earle	Green Bay, WI		Levers under platform sc
20,492	June 8, 1858	J F Keeler	Cleveland, OH		Levelling for bearings, pend. pointer
21,145	Aug 10, 1858	H B Osgood	Meriden, CT		Two-sided graduated beam
21,520	Sep 14, 1858	G H Smith	Glenwood, IA		Spring bal in knife handle for shop use
22,810	Feb 1, 1859	O W Jipson	Rochester, NY		Poises on steelyard platform sc
23,700	Apr 19, 1859	S Peirce	Cambridgeport, MA		Extending steelyard counter sc
24,023	May 17, 1859	W D Guseman	Morgantown, VA		Pendulum platform sc
24,669	July 5, 1859	J W Strange	Bangor, ME		Letter bismar on stand
25,148	Aug 16, 1859	F M Strong & T Ross	Brandon, VT		Counter platform w/ top pan steely'd
25,203	Aug 23, 1859	W W Kelly	Reedtown, OH		Counter steelyard w/ expanding pan
25,473	Sep 13, 1859	A Turnbull	West Meriden, CT	A Turnbull & J D Frary,	Spring & $^1/_2$ roberval counter sc
25,638	Oct 4, 1859	W D Guseman	Morgantown, VA		Pendulum platform counter sc
25,991	Nov 1, 1859	R F Wolcott	Claremont, NH		Poise on steel platform sc
26,026	Nov 8, 1859	T Fairbanks	St. Johnsbury, VT		Schickert's principle letter sc
26,757	Dec 20, 1859	E P Furlong & T Leavitt	Charleston, MA & Malston, MA		2 lever pendulum counter sc
26,795	Jan 10, 1860	S Squire	Brooklyn, NY		Hydraulic counter sc, elastic bag
27,140	Feb 14, 1860	H. Maranville	Clinton, OH		CCD
27,683	Apr 3, 1860	H N & J C Bill	Willimantic, CT		Pendulum counter sc
28,212	May 8, 1860	O C Squyer	West Dresden, NY		Flexure spring balance, oval
28,838	Jun 26 1860	W A Crowell	Salisbury, CT		Adjustable pointer on spring bal
30,922	Dec 18, 1860	J Holcomb	Brandon, VT		Lever design under platform
33,091	Aug 20, 1861	D C Lawrence	Cedar Falls, IA		Pen spring letter bal
33,403	Oct 1, 1861	A H Platt & W S Rosencrans	Cincinnati, OH		Tubular steelyard counter sc
34,355	Feb 11, 1862	T Fairbanks	St. Johnsbury, VT		Check & arrestm't, steely'd platform sc
34,417	Feb 18, 1862	T Fairbanks	St. Johnsbury, VT		Balance ball on steely'd platform sc
34,676	Mar 18, 1862	T Fairbanks	St. Johnsbury, VT		Folding pillar
34,754	Mar 25, 1862	J Holcomb	Brandon, VT		Support for scoop on counter sc
35,125	Apr 29, 1862	D C Lawrence	Cedar Falls, IA	A E Beach of NY	Spring bal made of 1 piece of wire
35,155	May 6, 1862	C Howlett	Hartford, CT		Circular pendulum letter/goods sc
35,348	May 20, 1862	J Howe Jr, F M Strong & T Ross	Brandon, VT		Lever & bearing design under platform
35,834	Jul 8, 1862	W Painter	Fallston, MD		CCD
36,290	Aug 26, 1862	W O C Fritschler	Brooklyn, NY		Pendulum counter sc with dial
36,678	Aug 14, 1862	F M Strong & T Ross	Brandon, VT		Lever & bearing design under platform
36,828	Nov 4, 1862	S G Barker	Carbondale, PA		Adjustable fulcrum & suspension point
36,918	Nov 11, 1862	L M Severance	Dixon, IL		Lever design under platform
38,221	Apr 21, 1863	C Downer	Philadelphia, PA		Tilting platform on steelyard
38,511	May 12, 1863	N Smith	Lancing, IA		Spring sc & $^1/_2$ bushel measure
39,145	Jul 7, 1863	S Harris	Philadelphia, PA		Poise curving round arc counter sc

40,400	Oct 27, 1863	H J Drew	Dixon, IL		Lever design under platform
40,434	Oct 27, 1863	L M Severance	Dixon, IL		Lever design under platform
40,906	Dec 15, 1863	H W Catlin	Burlington, VA		Resistant mercury & steely'd counter sc
42,722	May 10, 1864	J O Baudissin	St. Louis, MO	J O Baudissin & S Vangraafeiland	Hydraulic counter sc with elastic bag
43,511	July 12, 1864	J F Keeler	Pittsburgh, PA		Wrought-iron steelyard for platform
44,611	Oct 11, 1864	S Darling	Bangor, ME		4 fulcra & 4 graduations on bismar
45,770	Jan 3, 1865	H N Taft	Washington, DC		Calendar, pen rack & moving load letter scale
45,873	Jan 10, 1865	D D Steele	New Brunswick, NJ		Spring bal weighing bucket
46,592	Mar 28, 1865	W B Snyder	Lakeville, CT		Taring slide
46,992	Mar 28, 1865	H A Clum	Rochester, NY		Resistant mercury & spring counter
47,165	Apr 4, 1865	J H Conklin	Yorktown, NY		Arrestment for steelyard platform sc
48,211	Jun 13, 1863	H Saloshinsky	New York, NY		Counter spring sc
49,059	Jul 25, 1865	D A B Savy	Paris, France	E T Vanderburgh of Toulon, France	Pencil letter bismar
49,377	Aug 15, 1865	B Churchill	Wareham, MA		Counter postal sc
50,254	Oct 3, 1865	H Maranville	Akron, OH		Ruler, letter & coin sc
50,537	Oct 17, 1865	E Sampson	Lansingburg, NY	A C Hitchcock, of Green Island, NY	Lever design under platform
51,091	Nov 21, 1865	T Shedd & F Glockner	Williamsburg, NY		Child's exercise jumper & spr' weigher
51,226	Nov 28, 1865	R Shaler	Madison, CT		1/2 roberval, spring & dial
51,357	Dec 5, 1865	J Sangster	Buffalo, NY		Rocker with 2 fulcra on steely'd counter sc
51,416	Dec 12, 1865	O S Bliss	Fairfield, VT		2 linked steelyards

Instructions for Downloading Patents

1.. Go to Database: Patent Grant and Patent Application Full Text and Full-Page Images.
2.. Click on Patent Number Search
3.. Enter the Patent Number
4.. Click on Search
5. Click on the underlined Patent Nnumber
The text will say "The full text is not available. Click on Images button to view the full patent ".
6.. Click on Images button above.
(If you do not see an image, you will need to download free viewing software. To do this,
7.. Go back a page by clicking on left pointing arrow back button
8.. Click on Help
9.. Click on How to Access Patent Full-Page Images
10.. Click on the appropriate link to Alterna Tiff and follow download instructions)
This brings up page 1 of the patent
11.. Print it if you want to .
To view or print the entire patent, insert 2, 3, etc., in the box marked Go To and click Go.

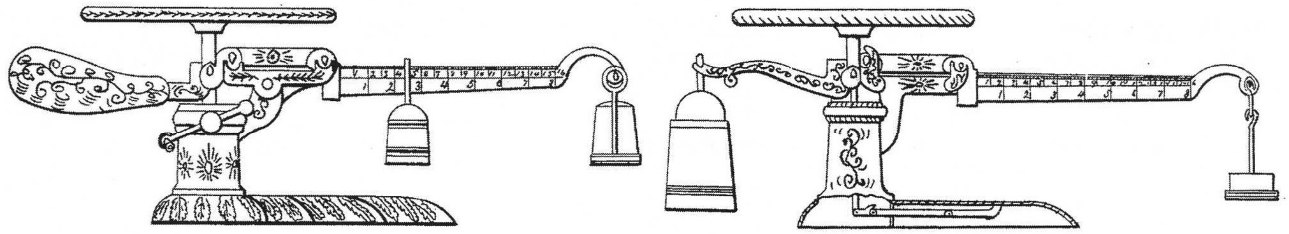


Fig. 21. No. 51,357 of Dec 5, 1865. Who is James Sangster of Buffalo, NY? He uses the terminology of a proper scale-maker. Is it possible that he was trained in the Southampton area of Hampshire, UK, by one of the British scale-making Sangsters?

Response on Robervals

FROM G NEWALL

The Beginner's Guide Part 2 made me stop and think. In the late 1940s I was appointed to a position, the purpose of which was to train a group of apprentices and, 'dilutees' in the theory and practice of scale repair and maintenance. Not more than ten young men between 15 and 25 years old but all with a lot to learn. It was evident early on that proficiency with their hands was well ahead of their understanding of the theory and, to counter this, situations seemed to arise spontaneously for a group discussion. I let them get on with it, taking little part until making a summary. In many cases they solved their own problems and felt better for having done so.

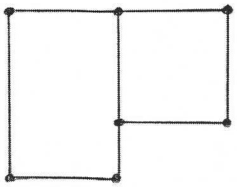


Fig. 1. ▲▲ For those people insistent on the parallelograms, they are still there, the larger on the left and the smaller on the right.

I cannot conceive of such an occasion at an ISASC meeting[1] but perhaps I can recall some of the outcome of a discussion on roberval scales. Cost, asymmetry, the fact that the Board of Trade would not approve nor would anyone buy such oddities was beside the point: *would they work*? One of the early discoveries was that the legs need not be the same length.

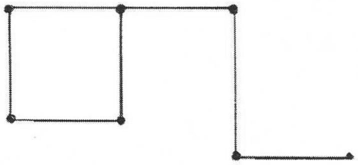


Fig. 2. ▲▲ Perhaps less acceptable is an arrangement with an outlying stay

Fig. 2 has the disadvantage that the goods carrier would tip slightly in use.

Finally, what about a scale that is half-roberval and half imperial on a common beam? And as the catalogues of a little over a hundred years ago states, for an extra shilling or two, they could even be made to vibrate!

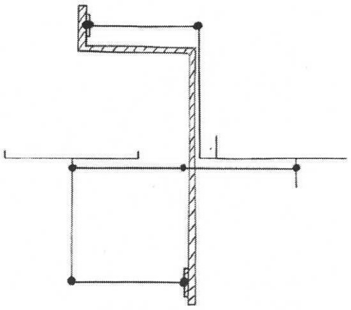


Fig. 3. ▲▲ The hatching indicates that part of the frame to which the stays are attached.

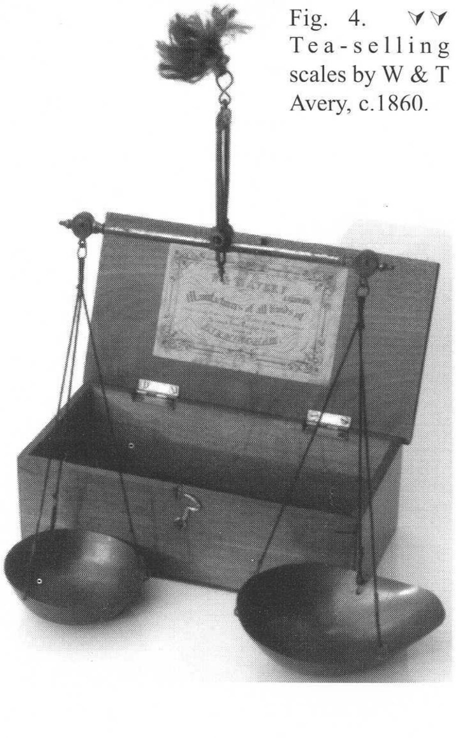


Fig. 4. ▼▼ Tea-selling scales by W & T Avery, c.1860.

---

[1] Editor: At the meeting at Loughborough on 7. 10. 01, an amazingly lively discussion arose on tea scales. Why were there no scratches in either pan of tea-selling scales? Was the tea approximately measured out into paper bags before weighing commenced? Why did no tea scales box owned by any member in the room contain weights? Was the tea (being checked) balanced against a packet previously known to weigh the correct amount? So many of these tea scales survive in their boxes, Fig. 4, that their use on pulleys above the heads of the shop-assistants seems exaggerated. Wouldn't the boxes have got lost?

What was the difference between a tea-sampling scale and a tea-selling scale? Oral tradition reported that either a silver sixpence (about 93 grains) or a copper penny (about 147 grains) might be used instead of a captive tea-weight. Why was such a large sample as a penny's weight used in some companies? Were employees of the tea importers tasting samples to check their flavours in order to produce a mixture that would satisfy their wholesale customers? Were blended samples tried by representatives and grocers before an order was placed?

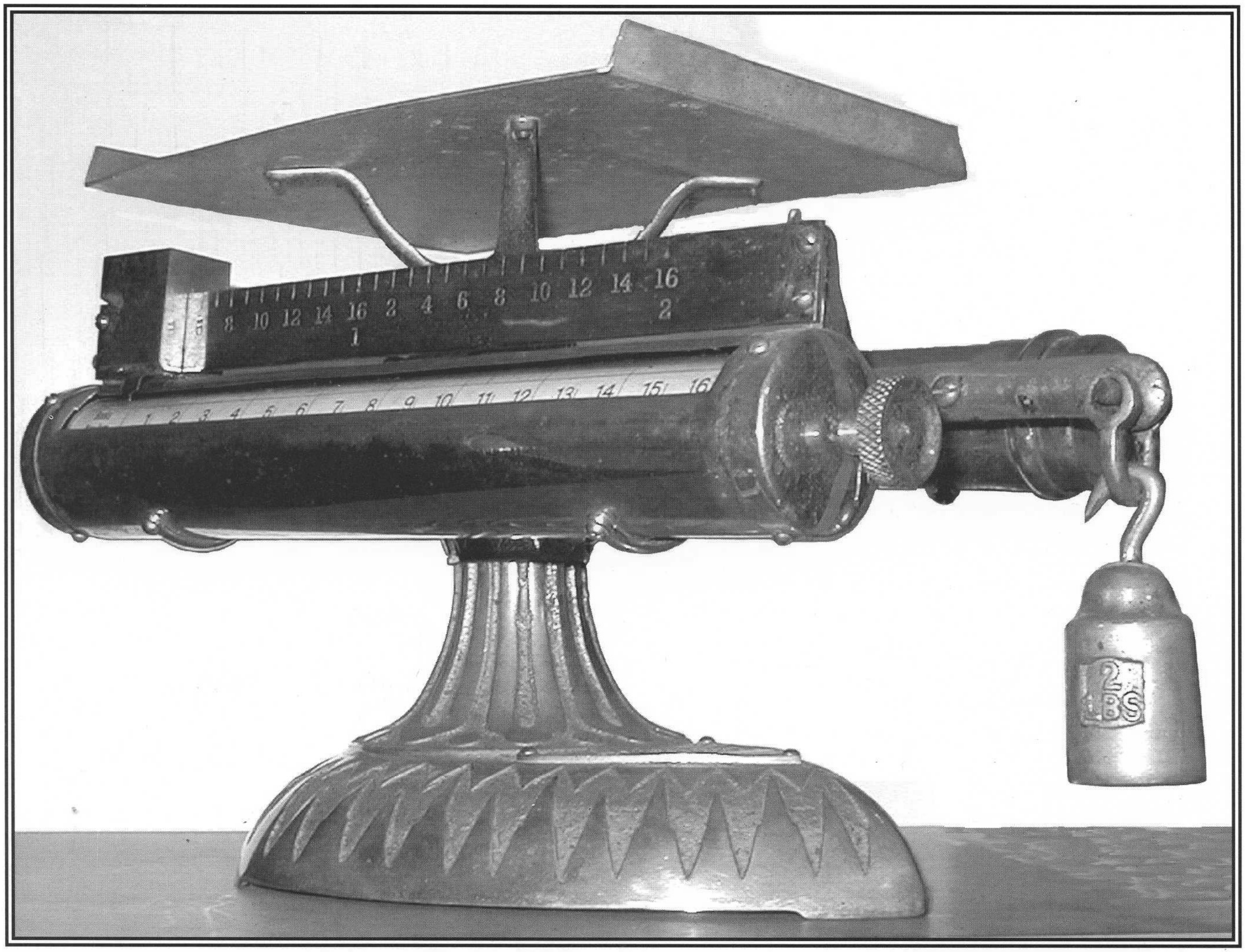
ISASC®

EQUILIBRIUM®

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

2002—ISSUE NO.2

PAGES 2673-2700



Cover Picture

This steelyard is a computer scale made by The Computing Scale Co. of Dayton, Ohio. It was patented, as no.116571, on 13 February, 1894.

The tear-drop shaped base, $7^{1}/_{4}$ x 3 inches, is polished nickel-plating. Under the beam is a $10^{1}/_{4}$ inch tube with 9 x $^{1}/_{2}$ inch glass-covered opening for viewing the roller, moved by the knurled knob on the end of the tube, that indicates postage for letters, periodicals, merchandise, etc. The weight of the tube is compensated for by a second weighted tube, equidistance from the center of the scale.

It weighs up to 16 oz, capacity being increased by use of the weight, marked 2lbs, hung on the hook in the center of mechanism for storage and hung on the end of the beam (as in the picture) for use. It is all nickel-plated, and is $12^{1}/_{2}$ inches high.

Photograph by K Beyreis

COLLECTION B WRIGHT

ISASC
INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

EQUILIBRIUM is published quarterly in January, April, July and October

© 2001 International Society of Antique Scale Collectors ISSN-0893-2883

International Society of Antique Scale Collectors
Founded September 1976
Internal Revenue Service 501 (c) (3) EIN 36-2976411
3616 Noakes St., Los Angeles, 90023
Tel 323.263.6878 **Fax** 323.263.3147
www.isasc.org Thomas_Dooley@bbs.macnexus.org

Directors and Officers 2001*

President	Thomas Dooley*
Vice Presidents	Steven Beare*
	Jerome Katz*
	Ruth Hendricks Willard*
	Gerald Wilson*
Secretary	Norman Cima*
Treasurer	Edward Konowitz*
Executive Secretary	Jan Macho
President Emeritus	Bob Stein

For membership information contact
Steven Beare stevebooks@aol.com
7 East Brookland Avenue, Wilmington, DE 19805

Published with the co-operation and support of

ISASC Europe
Founded October 1993
CHARITY COMMISSIONERS FOR ENGLAND & WALES NO 1037558
P.O. Box 179, Headington D.O. Oxford OX3 9YP

Trustees and Officers 2000-2002*

Chairman	John Cheeseman
Treasurer	Ken Govier*
Secretary	Phil Holroyd*
European Representative	Serge Camilleri
Meetings Secretary	Janet Scarratt*
Publications Officer	Roy Ladell
Trustee	Brian Stimpson*
Information Officer	D Crawforth-Hitchins

For membership information contact
P.O. Box 179, Headington D.O. Oxford, OX3 9YP, UK

Editor: Diana Crawforth-Hitchins, **Tel** +01865 763096 **Fax** 01865 751797 les.hitchins@bcs.org.uk
Associate Editor: Ruth Hendricks Willard, **Tel** 415.566.9670 **Fax** 415.566.3666 rhwillard@aol.com

Cart Steelyards of East Anglia

BY J CARTER

It was about 8.30am. I was reading the supplement *What's On* from the local paper. My wife, Ann asked, "*Do you fancy going anywhere in particular today?*" We always go out for a ride on Saturdays; I said, "*Kings Lynn is having a Heritage Day today. I'd certainly like to see inside the property owned and used by the Hanse.*" Unfortunately the Hanse Building is now owned by the Norfolk County Council and has been converted into offices that are not open to the public.

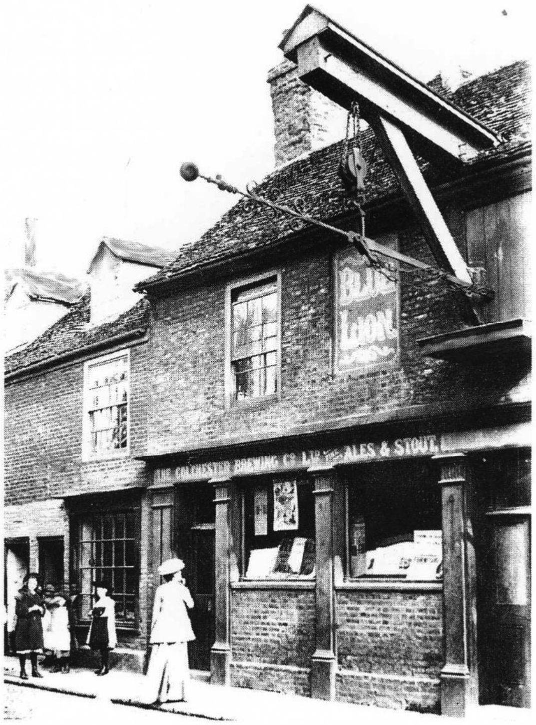


Fig. 1. ▲▲ The Blue Lion Hanging Chains in Kings Lynn in about 1900. The decorative part of the beam sticking out over the street is basically an ornamental extra, as a conventional "lump" of metal just to the left of the pivots would balance the mass of the beam adequately, if less attractively. The winch (that raised the steelyard once it was loaded, and the poise moved to approximately the correct position) shows clearly. The chains, long enough to loop round the cart axles, are draped round the beam towards the building, where an operator can get at them, and lower them (without knocking out the carter!) when needed.

After looking round several old buildings and cellars, we finished up at the Greenland Fishery House which was built in 1605; it was converted into a private museum around 1915. As I entered, there above my head, was a very long iron beam which belonged to a cart stilliard, Fig. 1, which hung from the Hanging Chains Inn at 69, Norfolk Street from around 1690 until 1883. The building still stands today, the Inn's name being changed to the Blue Lion, but the Kings Lynners still refer to the cart stilliard as *hanging chains,* [the chains having been used originally to loop round the axles of the cart, so that the cart could be lifted free of the ground when the steelyard was winched up] and so it became known as *The Blue Lion Hanging Chains*. I was impressed. What a beam! It's almost 20 feet long. See Fig. 1. A plaque stated that it was mainly used for weighing bark brought in from the neighbouring estates for local tanneries, and mentioned two other cart stilliards, one at Soham in Cambridgeshire and one at Woodbridge in Suffolk.

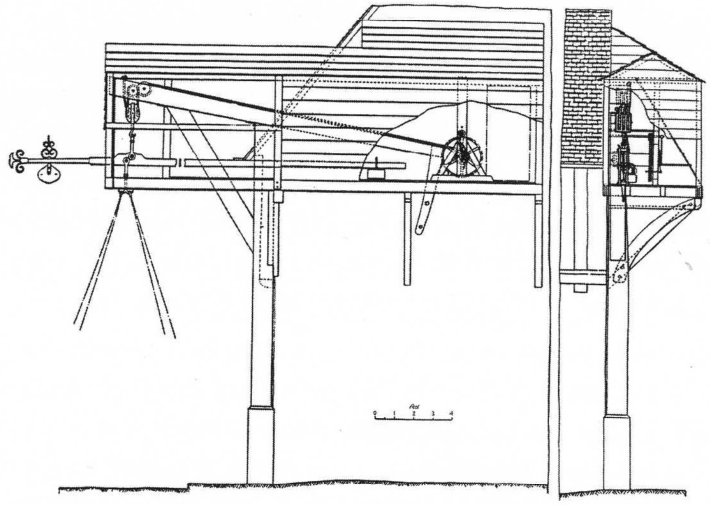


Fig. 2. ▲▲ Diagram of the side view and the end view of the stilliard at Woodbridge, Suffolk. The wheel at the rear of the supporting bar was connected to the winch at the other end, and gently raised the stilliard until the cart was swinging in the air. The operator must have had a strong back, to slide/lift the poise along the beam.

This aroused my interest in cart stilliards. The account book, of weighings for the Kings Lynn stilliard from 1862 to 1882, has survived. Inside the account book was an original weigh-ticket dated 15th May 1875. On the ticket the stilliard is called the Weigh Engine, East Gates. The ticket recorded a 30cwt load of bark. The loads of bark averaged about 2 tons. There are a few gross weighings of 70cwt ($3^{1}/2$ tons) recorded in the book. It is thought that a supplementary poise must have been used. Two poises? That's not something I'd thought of.

The following Wednesday I decided to go to Soham. I found the stilliard on the Fountain Pub, Fig. 3, and had a good look at the building from the roadside. While looking, a man came towards the pub on a bike, so I said, "*Good morning. They won't build any more of these*", which started a conversation. He said to me, "*You want to go and see Fred at the Funeral Parlour. He's the one that knows about the stilliard. Tell him Tinker sent you.*"

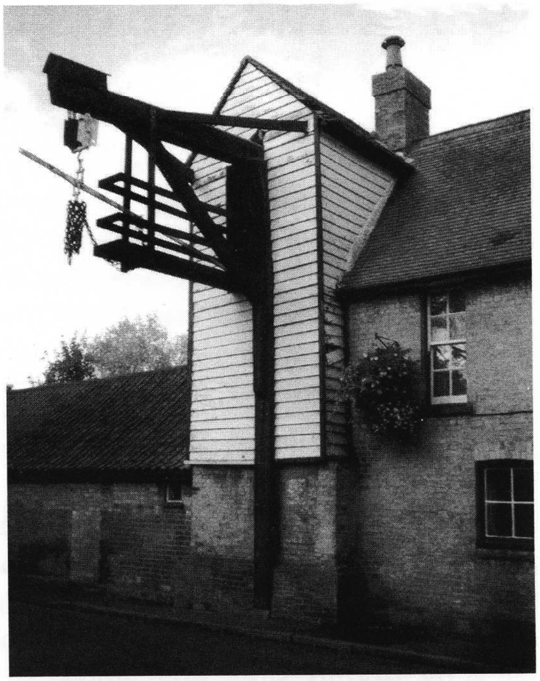


Fig. 3. ▲▲ The stilliard at Soham, Cambridgeshire as it is today. The exception height of the mechanism has allowed it to be left in situ, as modern traffic can drive under it safely without damaging it. The beam is strictly utilitarian, with no ornamentation, but the chains and the winch have survived, with the specially-built clap-board building.

I opened the door to the Funeral Parlour and was greeted by sombre music and a selection of head-stones. I could see a coffin being pushed across the yard on a trolley. I thought to myself, "*This is a strange place to be seeking information about a cart stilliard.*" A figure appeared in the archway. I said, "*I'm looking for Fred. Tinker sent me*". "*I'm Fred,*" he said, so I told him about my interest, and he told me that it was his wife Lucy who had all the information. "*Leave you name and 'phone number and I'll get Lucy to 'phone you.*"

Fred said, "*Have you been to Jones' waiting room? Jones is the dentist past the library. In his waiting room is a selection of photographs of old Soham. Tell his girls that Fred sent you.*" So off I went to Jones the Dentist. On entering the waiting room I said, "*My name is Carter. Fred sent me. Could I please look at your old Soham photographs?*" One of the photographs showed Lucy's father's lorry being weighed by the cart stilliard when he was in the process of renovating the building. (Not a true weighing, of course, because there was no poise.) By now I felt I had achieved as much as I could on this visit so I returned home quite pleased with myself.

Within a few minutes of reaching home, the 'phone rang. It was Lucy. She told me that in the late 1920s her father was mainly a funeral director in the winter and a builder in the summer, and in 1929 had renovated Soham cart stilliard. She had several photographs, press cuttings and quite a lot of other written information. She said that she'd put copies in the post, but it wouldn't be for a week or so as the following Sunday was the Soham Pumpkin Fayre. I said we'd make ourselves known to her at the Fayre.

Saturday came and we met Lucy and Fred at Soham Pumpkin Fayre. To my surprise she gave me an envelope full of copies of photographs and newspaper cuttings, etc of the Soham and Woodbridge cart stilliards. The earliest reference I have seen to the Soham stilliard is 1709, when £1..6..0 was paid to "*Edmd Rumbelow for drink and the use of his steyliard (sic) to weigh the church bells*", information in the Soham Church records.

As my interest was running very high, within two days I was at Woodbridge, Fig. 4. I knew there was a museum there but their information was very sparse so I decided to try the library next. There, in a glass-fronted cabinet, were the records of the Woodbridge historian, Major E R Cooper. Amongst the drawings and pictures was a paper "*The Stilliard at Woodbridge*" by Cooper, read in Ipswich on 8th June 1939, revealing all. I photocopied the lot for my file.

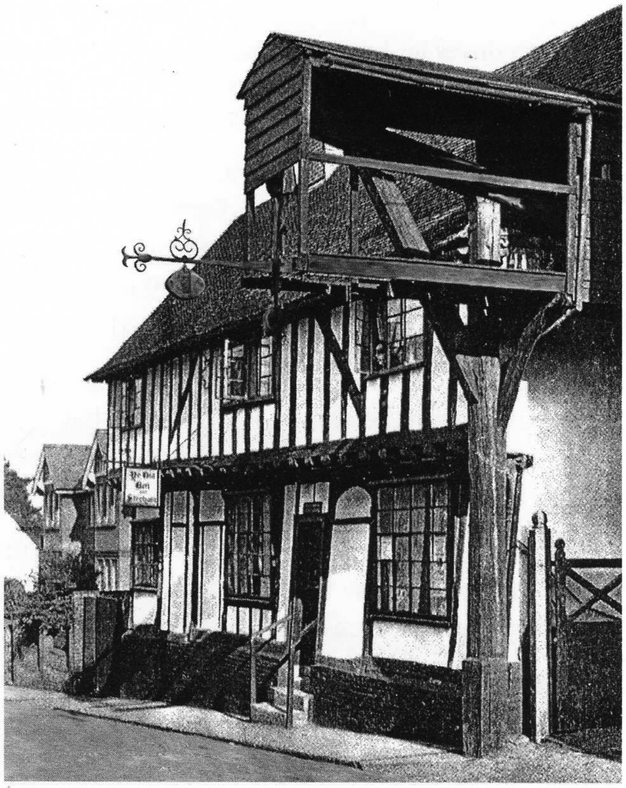


Fig. 4. ▲▲ The stilliard at Woodbridge, Suffolk as it was, outside the Bell and Steelyard Pub. The support tree is not concealed inside the building, so it is possible to imagine 41/2 tons of cart and load swinging over the street. Weighing on a gusty day must have been quite hazardous!

As Ye Old Bell and Stilliard Pub was just up the road, I thought I'd see what I could find there. I told the barmaid that my hobby was collecting scales and weights, etc, and that I was interested in the cart stilliard. She showed me framed newspaper articles which hung on the wall; also a book called *Inns and Pubs of England*, that had a detailed description of the Woodbridge stilliard on page 122. The article stated that the stilliard was used mainly to enforce the law that the wagon plus the load should not exceed three tons. I had thought that the weighing of the carts was only to ascertain the weight of its load, and maybe for road tolls. I have read since that the Ipswich - Claydon road was turnpiked in 1711 and that the Turnpike Trusts imposed heavier tolls on narrow-rim wheeled carts because of the damage they did to the surface of the road.

But, to cap the visit, there in the large fireplace is the only cart stilliard poise that exists in the UK, unless there is a member who knows differently? I am told that it weighs 108lbs. It consists of a large block of lead with two iron loops bolted to the top, one inside the other. The outer loop is there to manhandle the poise, and the inner one to rest on the beam.

To weigh with a Cart Stilliard:

The carter places his cart directly under the protruding beam and the operator releases the four chains from above, and descends to loop them round the cart axles. The horse is removed from the shafts. The stilliard operator climbs the stairs and winds the stilliard up until the chains are taut, then he slides the poise along the beam until the cart lifts off the ground. He takes a reading, deducts the previously-known weight of the cart, and thus knows the weight of the load and notes it down. He lowers the cart, descends the stairs, helps the carter to back his horse into the shafts, removes the chains, climbs the stairs again, and loops the chains up out of harm's way. The carter drives his cart on.

To weigh with a Weighbridge

The carter drives his horse over the weighbridge platform and off the other side, so that the cart alone depresses the platform. The operator stands by the steelyard and moves the poise along, probably in view of the carter. He deducts the weight of the cart and knows the weight of the load to note in his book or to write a ticket. The carter drives on.

In the paperwork from Lucy and Major Cooper there were several references to visits made by William Benton who was head of Avery's Research Department in 1929, and the first curator of Avery's museum. Howard Green, true to form, God bless his cotton socks, sent me a pile of copies of notes etc, of Benton's visit in 1939 to the existing cart stilliards of East Anglia. William's notes make fascinating reading. He met local historians and took measurements.

I have seen a letter from a Mr. Rex Wailes, who in 1963, was a consultant to the Council for British Archaeology, and he was of the opinion that there were about 70 cart stilliards in the country in the 17th century. I know of nine, plus one other possibility, so where were the other 60?

I asked myself why there were at least three of the cart stilliards of East Anglia still in use in the 1880s when the Cart Weighbridge had been invented in the early 1740s? Cost, maybe? Who knows? I don't know how many of you have had a go at research, but that chance meeting with Tinker opened the treasure chest for me.

Photographs in books were not available until around the 1880s, by which time most cart stilliards had been replaced by cart weighbridges. With the cart weighbridge, the weighing process was speeded up and allowed my ancestors to spend too much time in the pubs!

If there is a member who has information or maybe a photograph of other cart stilliards, please may I have a copy? If there are members who would like to find the cart stilliards in their areas, I can point them in the right direction and I will help all I can. There're only about 60 to find.

P.S. Samuel Pepys wrote in his diary that he drank beer in the Stilyard Inn on Dowgate Hill, Thames Street, where Cannon Street Station has stood since 1885. I think this pub was named after a Hanse building.

P.P.S. In 1604 there was an officer in London called "Pricker of the Stilliard" who received a salary of £44 a year.

P.P.S. Mr. Robert Payne, surveyor, did a survey of Bury St. Edmunds in 1833. A steelyard is recorded in the description of Henry Rackham's house at 31 Botolph Lane. Was this a cart stilliard?

Contemporary Comment, 1818

Taken from the records of a carrier:
Whetstone Gate weigh'd the van to 2cwt over a load; Woburn the same, Harboro' the same, altho' Whetstone was the only one that demanded the money.

[It is interesting that the same load was weighed three times during one journey of 60 miles. How long did each weighing take? Why did only one weigher demand the money?]

My Bankers' Scale

BY S MALTER

A rarity by H Sutcliffe & Co.

Of all the weighing instruments ever made, I think the beam scales are the most beautiful. The exact definition of a beam scale is rather simple; it is an equal-armed weighing instrument with the pans below the beam.[1] They come in a wide variety of sizes, shapes, and materials: brass, bronze, iron, steel, stone, bone, and wood. At least one famous balance was made of electrum, an alloy of silver and gold, by Ramesses III, Pharaoh of Egypt 1194-1163 BCE. [2] These are the most versatile of all scales, as by the simple expedient of changing the weights they can be used in any weight system, any country, or any century.

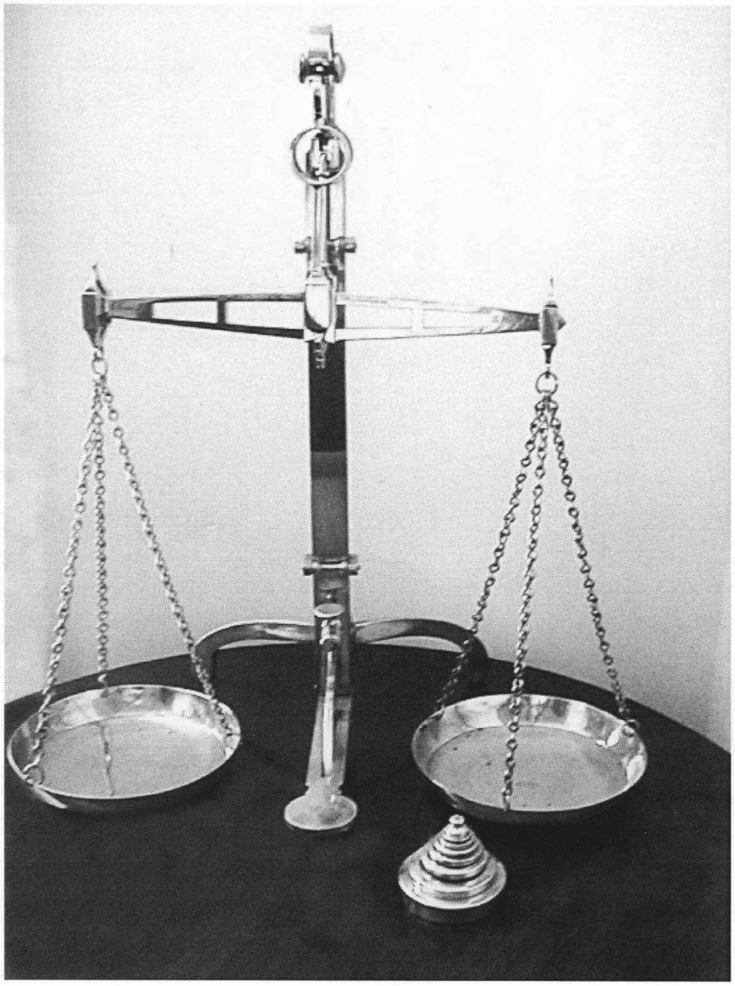


Figure 1 ▲▲ A representative of Lloyds of London used this scale in Hong Kong around the turn of the century. The set screw in the center will position the pans at various heights above the counter, suggesting that this scale may have been designed for use as an imposing showpiece.

Their documented history goes back to the tombs of the Egyptian Old Kingdom, c.3800 BCE, and is featured in drawings and paintings of many cultures to the present day. Even as other mechanisms were developed--the steelyard, bismar, roberval, spring, platform, and so on--the equal-arm balance continued to be preferred for fine weighing. Merchants traveling through Europe and Asia always carried their personal pocket balances with them. Money changers and bankers had a more elaborate type of beam scales, from small pocket ones in elegantly carved boxes to large scales on a stand or drawer. Throughout history, beam scales have provided the precision required by laboratories of all kinds. Even with the advent of electronic scales, they continue to be used in weights and measures departments today.

Beam scales are probably the most popular of all styles for their symbolic and decorative value. Most collectors have at least one. They are often prominently displayed in law offices, banks, laboratories, government buildings, financial institutions, and fine restaurants

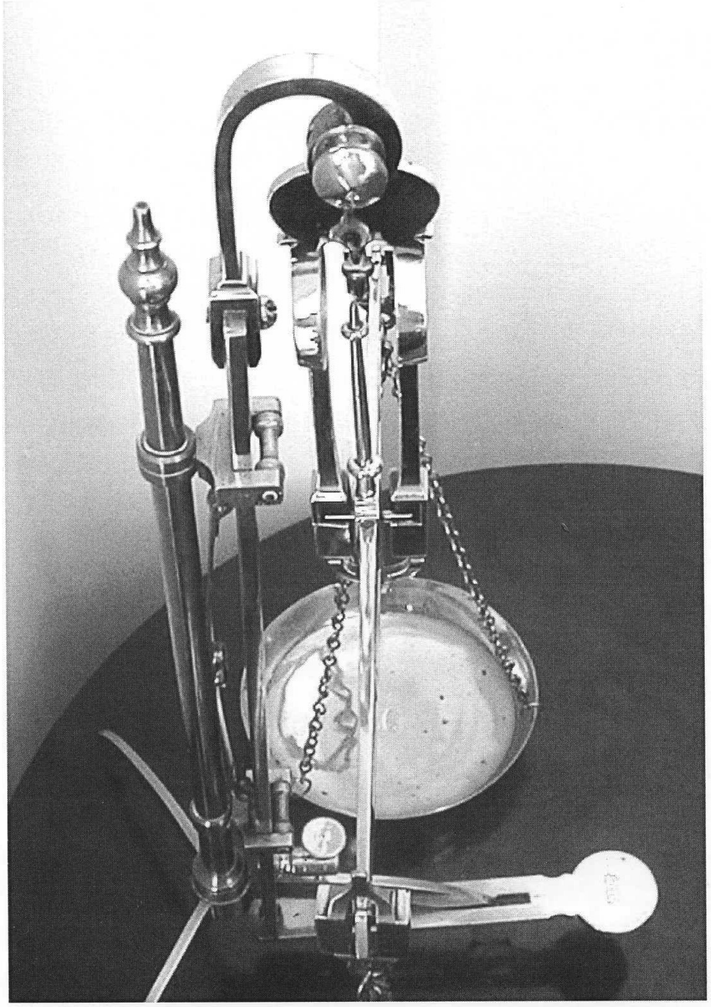


Fig 2, ▲▲ View of the relieving mechanism. When the key is depressed, the hanger rides up and down on the wheels at both ends of the spring, which is hinged in the middle to accommodate the various elevations of the pans.

This elegant scale is one of my favorites. It was produced by H. Sutcliffe & Co, 49 and 51 Thomas Street, Manchester. The Sutcliffe firm operated at least from 1826 to 1913, but was known primarily for its iron weights and shop scales. After considerable searching, I have found no reference to another Sutcliffe bankers' scale.

The overall height of the scale is a dignified 23ins and it weighs an impressive 15lb 3oz (yes, I weighed a scale!). The lattice beam is 13ins long. It is marked "H Sutcliffe & Co Manchester, Class 1, To weigh 2lbs" on both sides. The steel knife-edges rest on agate bearings. The pans, which are 7ins in diameter and 1ins deep, are marked in the center with the maker's name and address. The pans are stamped on the bottom with the number 2 and a date that can only be made out under high magnification. At first I thought it said 1877, but I later learned that the designation Class 1, which signifies a scale to weigh something precious like bullion or coins, was only used between 1893 and 1907. Therefore the scale must have been made in 1897.

The shears are brass and the sight-holes of the scale measure 1fi inches in diameter. The slide is made of a copper-surfaced material, giving it an unusual contrast of materials and colors. The pedal is also of interest because of its size, 2ins in diameter. It too is marked with the maker's name and address. But the weights were added by the dealer.

I purchased this scale in 1992 from an antique dealer on Cat Street, Victoria Island, Hong Kong. I actually paid more than I should, the sum of $3000.00 Hong Kong dollars, which at the time equaled $600 US (about £400). He told me that this particular scale was made for a gentleman by the name of Peter Smythe who worked for Lloyd's of London. The Smythe family moved to Hong Kong at the turn of the twentieth century and he purchased the scale from their estate in 1986. I was unable to find any further data on that family.

But what about the maker? What else did his firm produce? Although I have never seen another Sutcliffe scale,. two known examples of H. Sutcliffe's work are a 4lb flat round iron weight marked

"H SUTCLIFFE & Co." and a round pot plate with a transfer picture (decal) on it "H SUTCLIFFE & Co. SCALEMAKER ETC, 49 THOMAS STREET, SHUDEHILL, MANCHESTER".[3]

After several unsuccessful attempts to learn to learn anything more about the maker I turned to our Editor who provided the following information.

Census records establish their business address as 49 and 51 Thomas St., Shudhill, Manchester, in 1872. By 1883 the firm had expanded its quarters to encompass 33, 49, 51, and 53 Thomas St., and they were still at those addresses in 1910. They often used just 49 Thomas St. as the main address. The Sutcliffe family is something of an enigma. The name was common in Manchester; 79 male H Sutcliffes and six Reuben Sutcliffes appear in the census of 1881. It was impossible to identify which was 'ours' from the Thomas St address, because apparently it was a business address, not a residence, so the census takers didn't record the occupants.

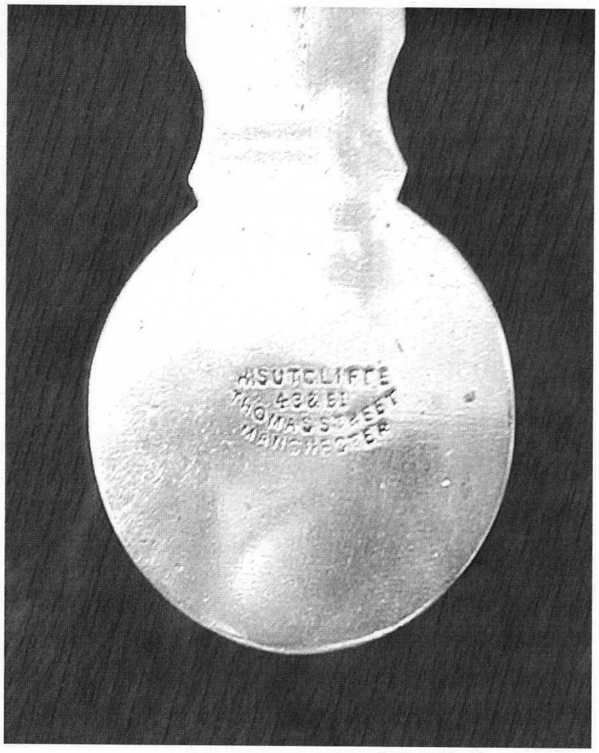


Fig. 3. ▲▲ The maker's name and address are prominently stamped on both sides of the beam, in the center of each pan, and, as shown here, on the pedal, which is a generous 2ins in diameter,

In a Whites' Trade Directory of 1875, they are called "Scale & Weighing Machine Maker at 33, 49, 51 and 53 Thomas St. Patent Moveable Pillar Scale. Agent for Avery Patent Agate Scales". The Moveable beam was moveable in that it had a relieving mechanism. The Agate Scales had box ends with the steel knives "sitting" on agate planes, a very popular end, reasonably rugged and reasonably precise, easy to repair, and much used by grocers. That design was Avery's answer to Sharkey's beam end.

In an advert of 1876, they state "Established over Half a Century", but that could mean either that H Sutcliffe himself started it about 1821, or that he bought a going concern that had been established in 1821. The advert of 1876 states "Grocers canister manufacturers, japanners, copper, iron, zinc and tin-plate workers, Scale and Weighing Machine Makers, tea, coffee and paint mills, Grocers general furnishers and importers of Russian bowls. Maker and patentee of the Patent Moveable Pillar Scale for lifting and at the same time throwing off the weight from the centres of the beam, whilst loading and unloading the scale, thereby causing the knife edges of the centres to retain their sharpness, without any repairing . . . Scales for Butter Merchants, Corn Dealers or Millers, Leather Factors, Wholesale grocers, Warehousemen, Silk Merchants and others. N.B. Address changed." This advert makes it clear that they were making the larger trade scales not fiddly little things like postal scales. And they were making scales for almost every kind of user except bankers!

At some point, the firm had a new proprietor. A shop scale exists with an equal-arm beam with Avery's Patent beam ends, on an iron and brass column, and a pot-plate stating "John Nesbitt, proprietor of H Sutcliffe & Co, Scalemakers etc, of 49 Thomas St, Shudehill, Manchester". (John Nesbitt's firm was renowned for its textile equipment that was highly desirable in Manchester, where half the world's cotton goods were woven in about 1860). The pot plate indicates that it was for use by a grocer weighing wet or sticky things like butter or cheese.

Another Sutcliffe, Reuben, is identified as the maker of two equal-arm shop scales having a lattice beam, brass pillar, and iron harp-top (decorative protection round the up-sticking pointer). The capacity of one is 10lb, with a balloon foot and marked on the beam "Reuben Sutcliffe, Makers, Manchester". This one was for sale on the web recently. A similar scale exists, but with a pot plate marked “WEDGWOOD CTY” on the edge. (CTY is correct. Another shape of Wedgwood plate is marked AFY so I suspect this is a factory code. Wedgwood supplied lots of scale-makers with plain white plates, for the maker to get transfer-printed.) The plate had a blue pattern round the edge and black lettering "Reuben Sutcliffe, CITY. Scale beam Manufactory, Concilio et Labore. 57 Thomas St, Manchester, Works, Lyon St, Garratt St, Oldham Road." The Latin tag means "Unite and Work."

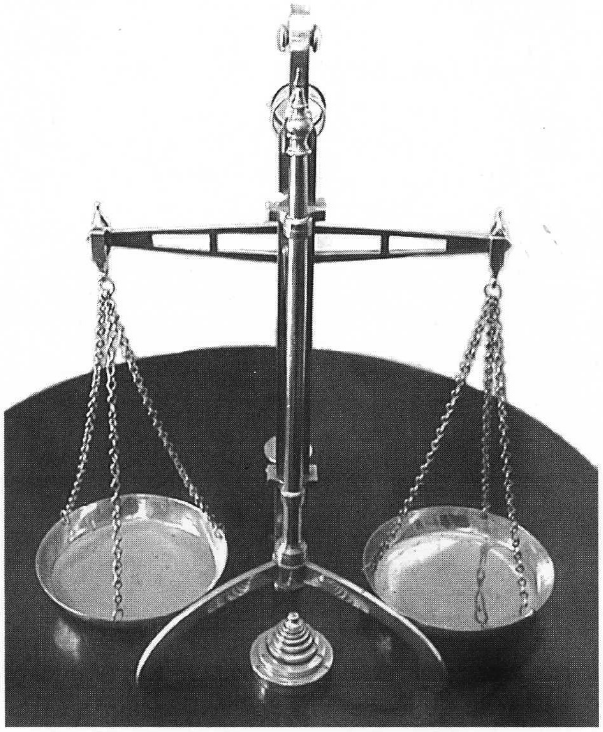


Fig. 4. ▲▲ At 7ins in diameter, the pans are slightly larger than the classic ratio of half the length of the beam.

Who was Reuben Sutcliffe? Perhaps he was a son or grandson of H Sutcliffe. In 1883, he set up a separate business at 57 Thomas St, four doors along from H Sutcliffe. In 1894 he added a second address, Lyon St, Garatt St., Oldham Road, Manchester, where he is listed as a scale beam manufacturer, not a supplier of shop necessities. By 1926, the firm had become Reuben Sutcliffe Ltd at the same addresses, still a Scales & Weights Manufacturer.[4]

No record has been found of any other H Sutcliffe bankers' scale. The firm must have gone into that specialty between 1876 and 1897, when my scale was made. As far as I know, the only reason for stabilizing the pans in mid-air is esthetic appeal. Could this distinctive mechanism have been designed primarily for symbolic display in Lloyds of London offices at home and abroad? Can any reader supply information about other Sutcliffe bankers' scales?

---

1. In the US, the term "beam scale" denotes a steelyard
2. Ramesses III describes that magnificent balance in the Papyrus Harris, now in the British Museum. Cited in Breasted, *Ancient Records of Egypt IV*, 144, 152
3. Michael Crawforth, "Iron Weights in Britain," EQM 638; D. Crawforth-Hitchins, "Porcelain, China or Pot?," EQM 1455
4. Sutcliffe research supplied by D. Crawforth-Hitchins

Beginners' Guide Part 4

4. Steelyards

Beam	Straight. Unequal arms
Resistant	Poise with moving pivot. MAIN FEATURE.
Resistant	Unique to the steelyard for which it was made
Fulcrum	Off-centre. Fixed pivot.
Load	Fixed pivot.
Stabilised by	Suspended from hook. Load below beam. Linkage.
Graduations for equal units	Equally spaced along beam.
Common names	Schnellwaage [quick weigher], beam (USA)

Hanging Steelyards

The advantage of a steelyard over an equal-arm scale was that one poise indicated the weight of all loads applied. For any traveller, one poise of say 10% of the weight of the load, was easier to carry about than weights that equalled the full load. For any merchant wanting a quick read-out without having to fiddle about with a stack of weights, a steelyard was an advantage.

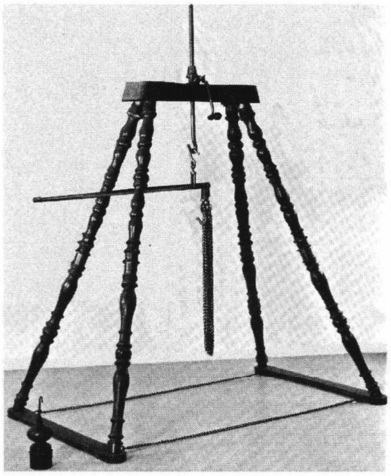


Fig. 1. ▲▲ Simple steelyard with one fulcrum, fixed in a frame, with a lifting rod that is wound up by a handle above the head of the user. The game (deer or wild pig) was suspended from the hook or in the chains, the poise was moved along the beam to approximately the right position then the handle cranked up until the load was coming free of the ground. If the poise was obviously in the wrong place, the load was lowered and the poise repositioned, and the handle wound up again. The operator would have held the end of the steelyard to prevent it tipping suddenly, and to catch the poise if it skidded along the steelyard and was at risk of falling off the end. German. Dated 1610.

The disadvantage of a steelyard was that any error was multiplied by the ratio of the steelyard, so any error in positioning the knife-edge of the load-pan/hook multiplied errors.

The other disadvantage of steelyards was that the graduations were placed to balance one particular poise. If that poise was lost, (and unattached poises were easy to lose) the user had to get one made of precisely the correct mass.

Steelyards were economical to make, light to carry, and took up little room, but they were prone to awkward slipping and sliding if handled by an inexperienced user. The poise went skidding down the beam, either stopping abruptly when it hit the stop or shooting onto the floor (or the user's foot) if there was no stop. Makers had ways of minimising the problem, the most obvious being the stop, or by putting a curved bracket between the shears and the rear end of the beam, so that the beam could only drop a little way before hitting the bracket.

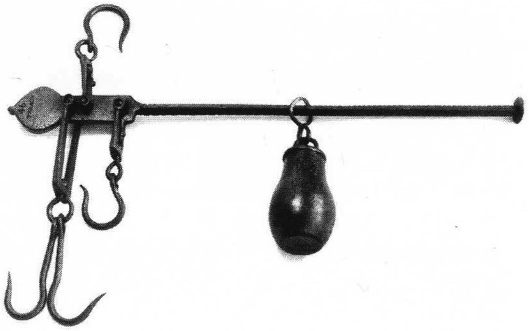


Fig. 2. ▲▲ Turn-over steelyard with two fulcrums. If used as shown, hanging from the shears nearer the load pivot, the heavier graduations are uppermost. If the steelyard is turned over, and the load hook swings round through 180°, the shears shown hanging down become the upper handle, and the lighter graduations are uppermost on the beam. Steelyard with a poise with, cast into it, "1^{1}/4", but actually weighing 1lb 3oz instead of 1lb 4oz. When a load of 2lb is applied, it balances when the poise is at 2^{1}/2lb. If a mass of 1oz is added to the poise, the 2lb load reads correctly as 2lb. So this steelyard would have suited a dishonest man selling goods. The heavy side is graduated 1, 2 and 3 only, indicating stones, [units of 14lb]. Steelyard punched "46 T BEACH", having a capacity of 46lb while having a poise only ^{1}/37 of the capacity.

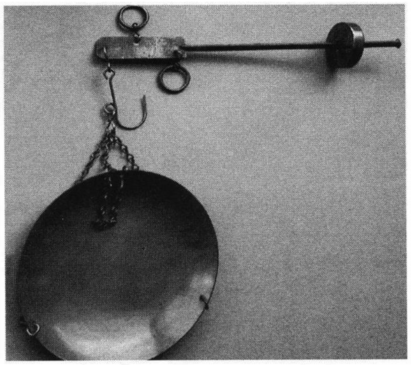


Fig. 3. ≺≺ The most basic, crude turn-over steelyard made of iron, country unknown. 12ins (300mm) long. Poise brass sliding along the beam and a heavy, well-made copper pan. No proper knife-edges. BUT it starts at zero, and has a stop to prevent loss of the poise. It has nicely spaced graduations of 20 units to the P [447grams], and goes up to 1^1/2P on the light side. The heavy side goes from 1^1/2 to 5P. Such nasty objects tend to be excluded from collections, but perhaps they should be included to demonstrate that users made do with the cheapest scales when necessary, or when they did not appreciate the need for greater accuracy.

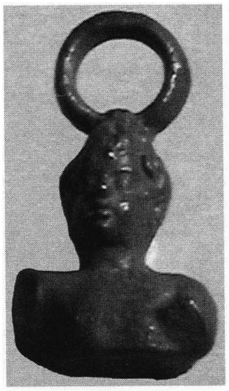


Fig. 4. ≻≻ Poise from a steelyard found in the ruins of Pompeii, a raffish town when it was destroyed, with many extravagant items intended to display the superior taste of the dubious inhabitants. But who could argue that this poise is tasteless?

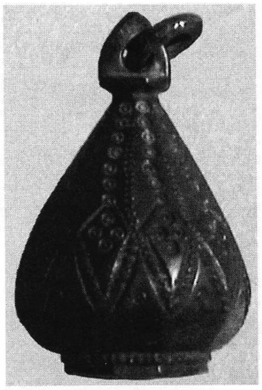


Fig. 5a. ≺≺ Poise from the Byzantine steelyard in Fig. 5b. Bronze. 177grams. The bird's eye dots are typical of Byzantine decoration.

Fig. 5b. ≻≻ Turnover steelyard of the Byzantine period. This choice steelyard is only 5^1/2ins (160mm) long, made of bronze. "Byzantine" covers the period about 500-1200AD, when the Roman civilisation was gradually collapsing, and Arabic influences were increasing.

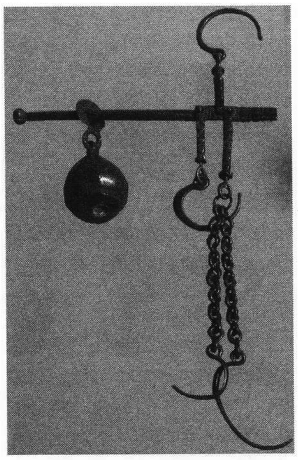


Fig. 6. ⋎⋎ Steelyards supported on a pillar, with a secondary bracket to prevent the beam tipping too much. The larger steelyard is by W & T Avery Ltd, Birmingham, for postal use. The brass beam is 10ins (252mm) long, graduated 0 - 8oz. The fulcrum has an open notch, whereby the beam can be slipped into or out of the bearing. The reason for this facility is not known, as the pillar and bracket are permanently mounted on the mahogany base. The letter hanger can also be detatched from the beam. Possibly it was to make packing the scale for shipment to the retailer easier.

The small steelyard is graduated for ^{1}/2 sovereign, 1 sovereign and ^{1}/2oz only, with a tiny brass slide on the load side of the fulcrum. for grains deficient.

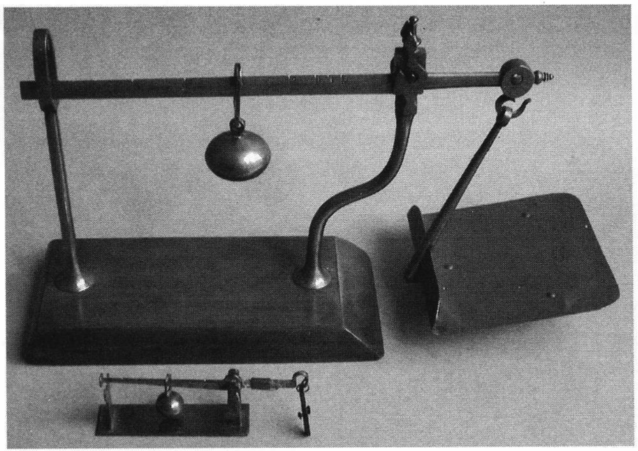


Fig. 7. ⋎⋎ A bracket goes from the suspension handle to the rear of the beam, neatly preventing the beam from tipping too far. Iron steelyard by W & T Avery Ltd, Makers, Birmingham, Class 2 to weigh 4lb.

In the centre of the rear is a lead plug stamped by the inspector because it was used for trade, to weigh bread. The steelyard was used on a bread van, and the bread was suspended by stabbing the prongs into the bread.

Made between 1893 and 1905, after which date Avery changed the design slightly.

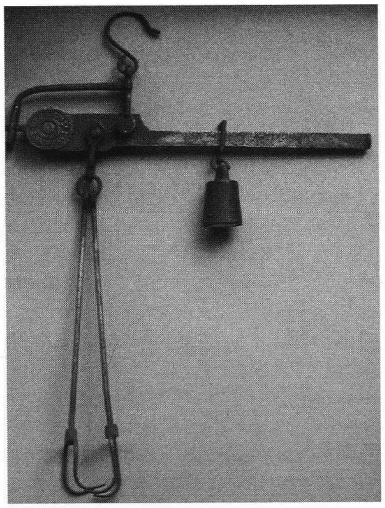
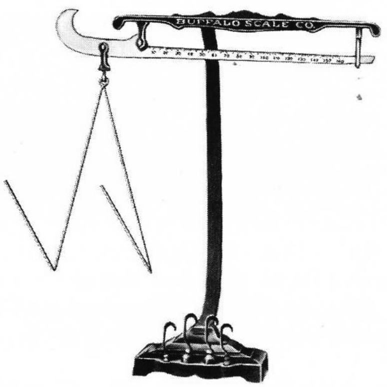


Fig. 8. ➢➢ Steelyard supported on a pillar, with a bracket to prevent the steelyard tipping too far. Also features four poises for indicating different weights. Buffalo Scale Co. paper scale with stand. *For determining the number of pounds to the ream by the weight of one sheet. Weights indicating 480 sheets and 500 sheets to the ream furnished unless otherwise ordered. The side of the beam ordinarily used is marked 160 and is called the heavy side. The other side of the beam, marked 40, is used when weighing very light sheets and is called the light side. When weighing on the heavy side of beam the larger poises, either the 480 or the 500 are used. When weighing on the light side the smaller poises, 480 or 500, are used.*


BUFFALO SCALE CO.

Supported steelyards

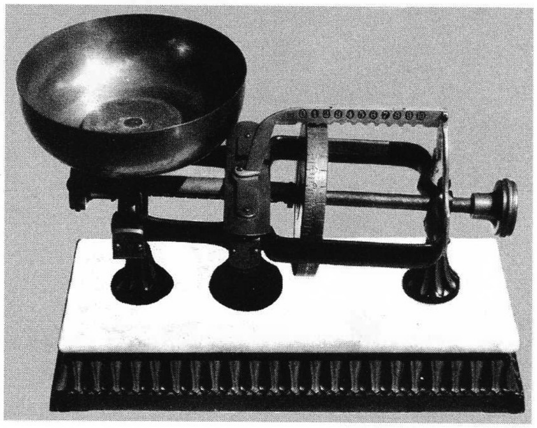
Mounting the steelyard on a pillar, instead of hanging it from a hook, made a more cumbersome scale, but allowed some stability to be built in. Instead of the bracket being attached to the steelyard, it was attached to the pillar or the base, but served the same purpose, preventing the steelyard beam from dropping too far. The bracket would also trap the poise on the beam, so the poise did not get lost.

Linkage at one end of the steelyard

Steelyards could be steadied by supporting the fulcrum with a pillar, and attaching some sort of linkage to the rear end. The linkages were attached to a base that prevented big movements of the whole structure.

By 1741 the first linkages were being attached to the rear end of the steelyard to make the platform scale. The visible part of the platform scale was at the top of the column. Most had a steelyard with poises. The little poises seemed much too small to indicate the huge loads on the platform. The apparent discrepancy was explained by the levers under the platform. The levers allowed (say) a hundred pound load to pull the rod in the column down by only ten pounds. The rod pulled the end of the steelyard down by that ten pounds, and the little poise of one pound had only to move a short distance along the beam to indicate a load of 100lb. This was a relatively crude indication of mass, but was adequate for wagon-weighing, warehouses, industrial use, and even shop use

Fig. 9. ⋎⋎ A half-roberval linkage under the pan. Also features a micrometer poise. Dodge Mfg Co, micrometer scale, stamped "Made in USA, 1860". Beam graduated 0-10lb, micrometer graduated 0-16oz by $^{1}/_{4}$oz. Courtesy F Eakin. Having the poise on a screw gave a very accurate read-out because the distance between each graduation is far greater round the wheel than the same gap between each graduation could be directly along the beam.



Linkages on small steelyards

The half-roberval linkage was widely used to stabilise the steelyard. The Americans used the half-roberval and steelyard for the majority of their counter scales. It was steady, it was quick to load and quick to read. Because of the disadvantages of potential errors mentioned above, European inspectors did not view this type favourably, but the Americans found it satisfactory for about 150 years.

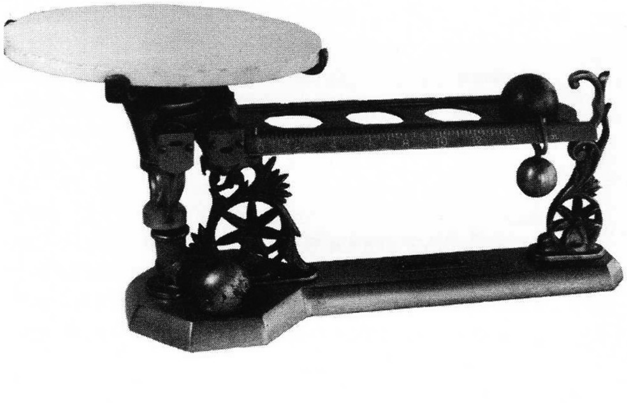


Fig. 10. ⋞⋞ Half-roberval linkage under the pan. Several poises added together to indicate weight. Henry Troemner Ball Scale. For weighing candy; if a 1lb ball were placed in the hole nearest the fulcrum it indicated 1lb, in the second hole 2lb, in the third hole 3lb and in the fourth hole 4lb. If more than one ball was used, the sum of the two holes' indications were added together. Capacity 8lb. The side beam indicated one pound by ounces. Sensitive to 4oz. This design was popular until c.1940. Courtesy F Schmerl

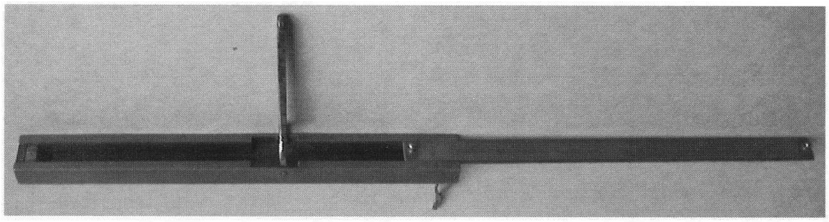


Fig. 11. ▲▲ British steelyard in the form of a narrow brass box with a lid that acts as the poise. The blued steel clip and handle are hinged to drop into the box when stored. The clip takes a standard imperial sheet of paper or card (and informs the user of the weight of a ream of that paper).

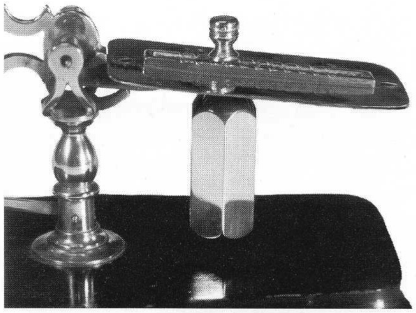


Fig. 12. ▲▲ The poise on a postal half-roberval and steelyard by Narcissé Briais of Paris, c.1870. The poise is hanging in a slot in the beam.

Schickert's principle was occasionally used, but obviated one of the advantages of the steelyard - its lightness - because the lump keeping the pan horizontal had to be very heavy.

The Caledonian scale of c.1800 used a unique system of linkages that produced a very smooth vertical movement of the pan, superior to the half-roberval system, but it was never widely used.

Poises

The pear-shaped poise was widely used by the Romans, but they soon found ways to prettify their steelyards. Sumptuous poises were used, little works of art, symbolising the protection of the gods, showing the good taste of the owner, adding a little frivolity to an otherwise staid tool of trade. Byzantine poises could be facetted and dotted, British postal scales might have poises shaped like a suitcase or a putti. As long as the poise was made for a particular steelyard, it had a good knife-edge where it met the beam and its mass matched the graduations on the beam, it could be any shape.

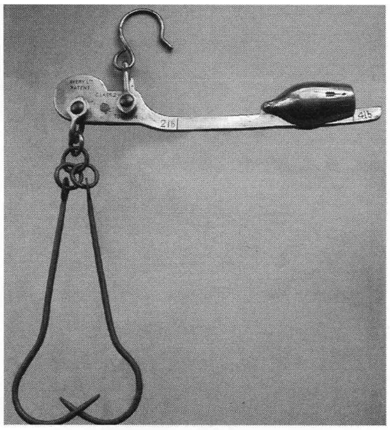


Fig. 13. ▲▲ British brass steelyard with a flip-over poise. Bread was sold as standard loaves of either 2lb or 4lb, so a simple captive poise like this was very practical. (Fancy bread recipes were exempt from this standard system and were sold on their appearance only). Patented March 2, 1885. Stamped Class C, used by inspectors to denote middling quality between 1893 and 1905.

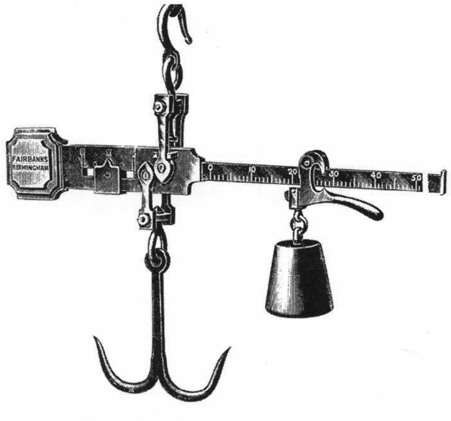


Fig. 14. ◀◀ The Counterpoise is fitted with Tandem Rollers which reduce friction to a minimum. The ball is self-locking to prevent any damage to notches. Fairbanks, Birmingham. Butchers' Steelyard made in 1915 to fit the British regulations of 1907. It vibrates like a scale beam, and indicates weighings from zero to its full capacity on one side. A small subsidiary slide is provided for sub-divisions of a lb..Capacities available from 60 to 400lb.

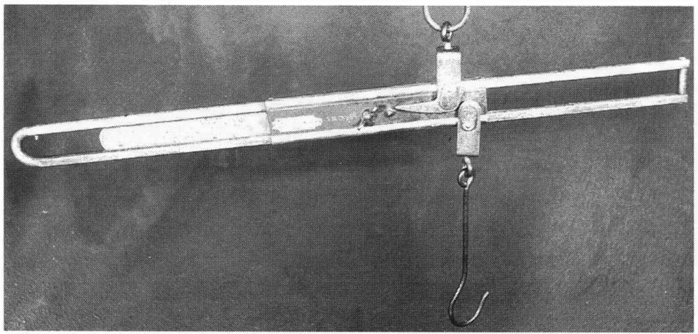


Fig. 15. ◀◀ German saddled steelyard. Although it appears to have no poise, it is merely an unexpected shape. The poise is the U-shaped rod going round the outside of the fixed steel beam. The fulcrum is fixed, the load hook is fixed and the poise (rod) slides to left or right, and the graduations on the U-rod are read off. The pointer attached to the handle points to a pip next to the nut, to indicate that the beam is exactly horizontal. The nut locks the saddle to the steel plate along the back, to tare the bucket for milk. Made by A Prutscher, Mech. Werkstatte, Sonthofen, Allg. Capacity 15 kilos.

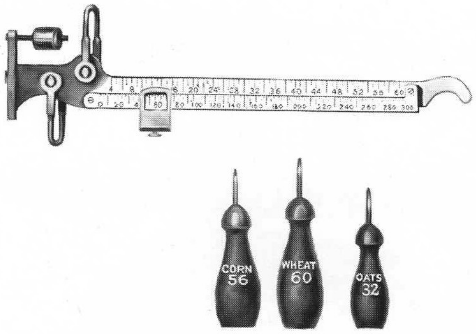


Fig. 16. ⮝⮝ Large steelyard made by Buffalo Scale Co in 1908, for use by farmers. The container (as big as an automobile) was tared using the captive poise on the front beam. The farmer chose the correct poise to hang on the rear beam, having ordered from the maker poises suited to crops he grew. If the wheat poise is hung in a certain notch, it will balance so many bushels of wheat, while the oat poise at the same notch would indicate the same number of bushels of oats, and so on.

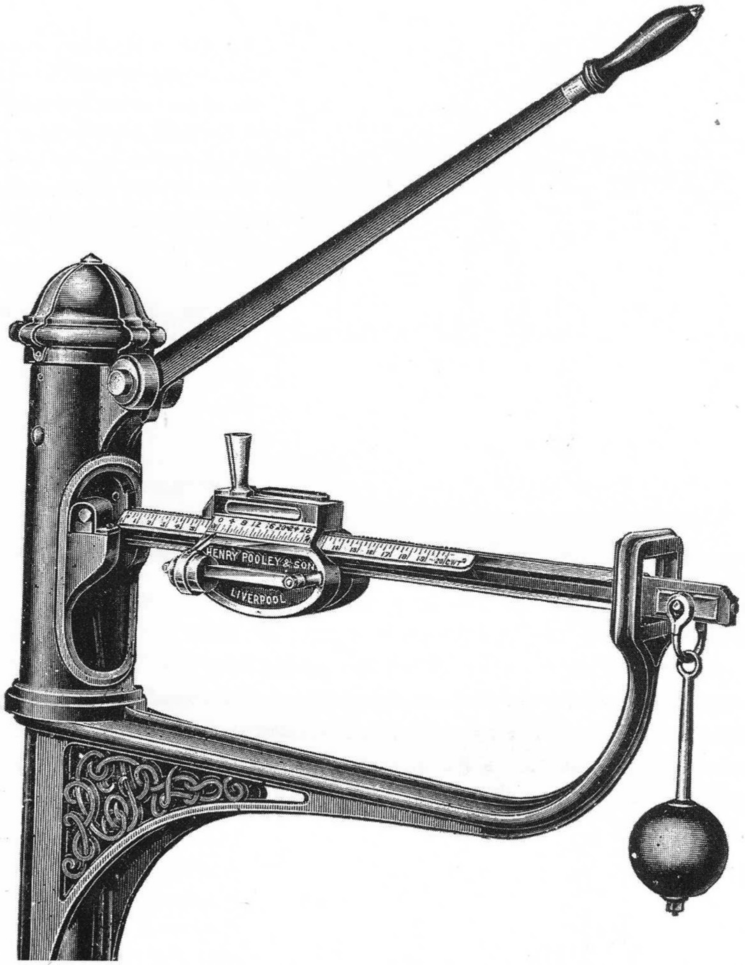
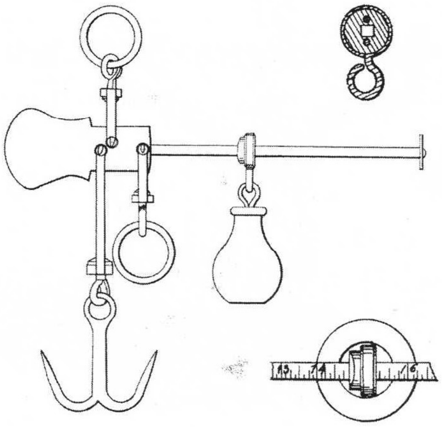


Fig. 17 ➤➤ Poise with a small sliding poise on it. The big poise indicates 0 -20cwt, and the little poise indicates 0-28lb. The handle above the steelyard locks the platform while it is being loaded, thus reducing wear on the knives. Made by Henry Pooley & Son, Ltd, Head Office Birmingham, in 1910.

Poises normally hung from a ring or saddle above the main mass. But here too ingenuity crept in. The ring might incorporate a brake so that the poise would not move until the user operated the brake. The saddle might swivel round the beam, minimising wear on the knife-edge. Poises could be slotted, and pushed onto a hanger at the end of the beam, so one pivot acted for several poises (the units indicated on each poise had to be added up by the user, which could lead to errors, especially if the poises had differing masses).

The poise was sometimes placed directly on the beam, without there being a pivot, as with the classic American cannonball scales (the balls needing to be added up to deduce the total). British coin scales sometimes had poises for specific coins, such as Cotton's sovereign balance, with the poise being accurately positioned by the "box" poise for half-sovereign taking another little poise inside the box, making the poise up to a sovereign's weight. Roll-on poises were mounted in a frame beside or beyond the beam, and located by grooves when they were rolled onto the beam. The poise might screw along the beam like a micrometer, an idea patented in Germany in 1885. The poise might be attached to the beam by a hinge, and the poise operate only on one side or, flipped over, on the other side of the hinge. The big poise might indicate bigger units, and have on it a tiny sliding poise that indicated small units. The poise might have a subsidiary poise hung

Fig. 18. ⮟⮟ American patent of 22 Feb, 1870, for a swivelling ring suspending the poise. William B Preston used this device with a turn-over steelyard of a design familiar to people of the later 18th century.



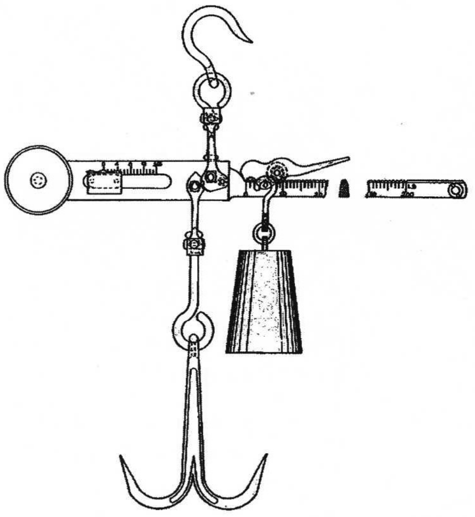


Fig. 19. ≺≺ A tiny poise on the "wrong" (load) side of the fulcrum, reading in total one division of the big poise. The bigger poise has a brake to hold the poise in its notch until the user wishes to move the poise.

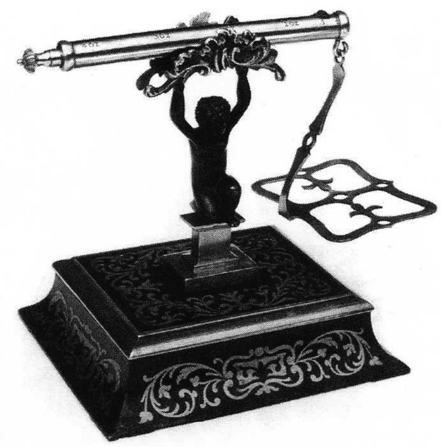


Fig. 20. ≻≻ Poise inside the steelyard tube. The tube has a slot along the top, along which the poise is slid. Design Registration of 20 Dec, 1839, by H B Wright of 44 Upper Marylebone St, London.

beneath it to weigh heavier items, as Benjamin Martin did on his ivory coin dot'chin.

It seems puzzling to see a poise on the "wrong" side of the fulcrum. The steelyard had a normal poise the other end of the beam from the load, plus a little poise the same end as the load. This little poise deducts mass from the load as it moves towards the fulcrum but the graduations read off as getting larger as the little poise moves towards the fulcrum. The maker had the steelyard in equilibrium when the little poise was next to the load-pivot. After the big poise was placed on the beam as near to the correct weight as possible, the little poise was moved towards the fulcrum under exact equilibrium was achieved. Then the graduations indicated by the big poise were read off (say, 6 drachms) and the graduations indicated by the little poise (say, 15 grains) were added to get the total.

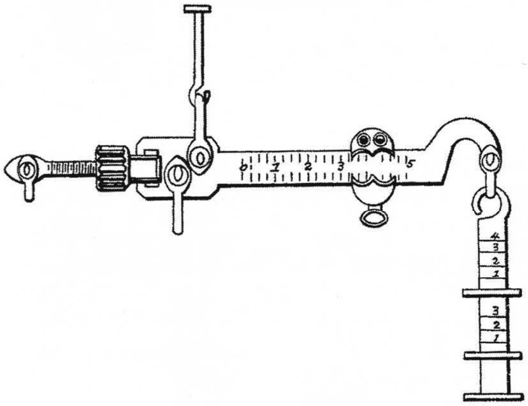


Fig. 21. ≺≺ Proportional "weights" slot onto a hanger at the end of the steelyard of a huge platform scale. The hanger has poises at the bottom to balance the steelyard, the next section up carries poises to tare the empty railroad car, and the top section of the hanger carries poises to balance the main part of the load of some tons, all poises being small enough to hold in the hand. The sliding poises, one top and one bottom of the beam, indicate the fractional parts of the load. J F Keeler, patent no. 57,921, of 11 Sept, 1866.

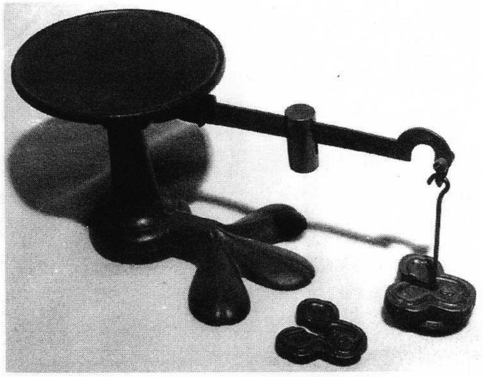


Fig. 22. ⋀⋀ Proportional poises shaped like clover leaves. Although it is a small counter scale, the capacity is high, being 24lb or 36lb. The larger poises are marked 6, and five of those balance 30lb. The thinner clover leaves balance 3lb, 2lb and 1lb, and the sliding poise gives a more accurate indication of 0-16oz. Made by Jones of Binghamton, whose trade mark was a clover leaf. Made c. 1900.

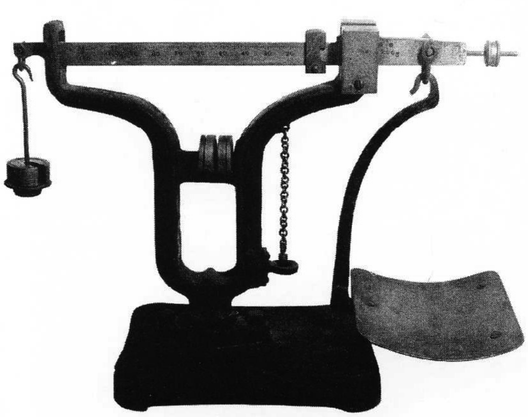


Fig. 23. ≺≺ Japanese steelyard with slotted weights for 500, 200, 200, 100 and 100grams. The beam is graduated 0 - 100grams. Capacity 1200gms. The chain with the knob at its bottom goes into a hole which indicates that it is level. Probably a postal steelyard. 290mm high. The white metal beam has red numbers. Courtesy W Doniger

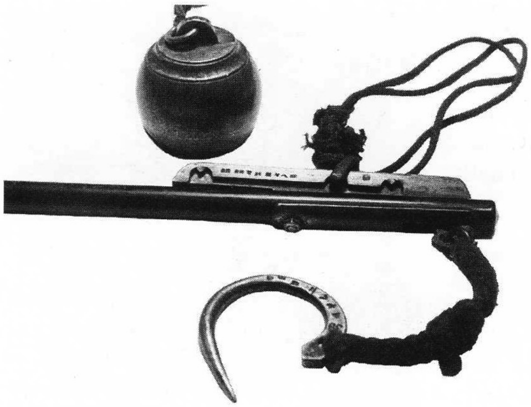
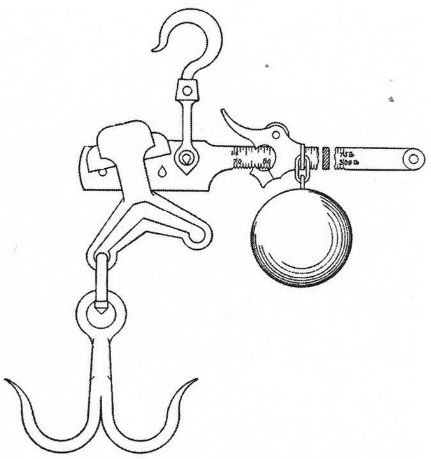


Fig. 24. ◄◄ Three fulcrums on a Japanese steelyard. Made in Hokaido. Leather sheath with bamboo stiffener, and draw-string at top. Intended for carrying in the belt. Courtesy N Sturgess

Fig. 25. ►► Instead of a turn-over steelyard with two load positions, this mechanism has a tipping pivot, patented by C H Bartlett in UK in 1894.



The fact that different poises indicate different masses can be useful. One steelyard might have a set of poises all to be used with one set of graduations, because each poise was made for a product of a different density.

Proportional poises

Because of the levers under the platform plus the leverage of the steelyard itself, the proportional "weights" are really poises with a ratio dependent on the levers. Poises that represent 1cwt each might weigh a mere one pound each.

Half-roberval and steelyards often have a hanger at the end of the beam, and slotted poises that are put onto the hanger, to be added up by the user. The poises have cast into them, perhaps, 6, meaning 6lb, but they are proportional to the leverage of the beam, and might really weigh 1lb, and another poise from the same set say, 1, meaning 1lb, really weighs ¹/₆ of a pound, or 2.66oz.

Multiple fulcrums

We talk of a "fixed fulcrum" for all steelyards, then, in the next breathe, talk about more than one fulcrum on a steelyard. Think of each fulcrum as belonging to a different steelyard, then think of the one beam being used for more than one steelyard, assembled into one instrument.

The turnover steelyard was the most basic, and most used, of the multiple-fulcrum steelyards, but during the 19th century makers devised various ways of slipping the fulcrum from one position to another, giving a choice of graduations to be read while using only one poise. It was necessary to have a gentle means of slipping the fulcrum, that didn't damage the knives, and a secure position for each fulcrum that left no doubt as to which position was in use.

Steelyards very rarely had more than three fulcrums, because the user might get confused if there were four sets of graduations on one beam. The Japanese used three fulcrums regularly, with a simple silk cord and tassel at three distances from the fulcrum.

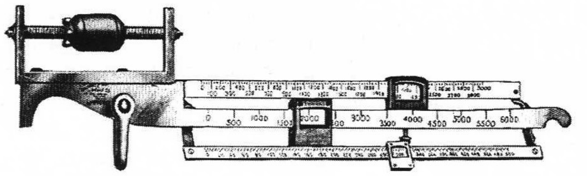
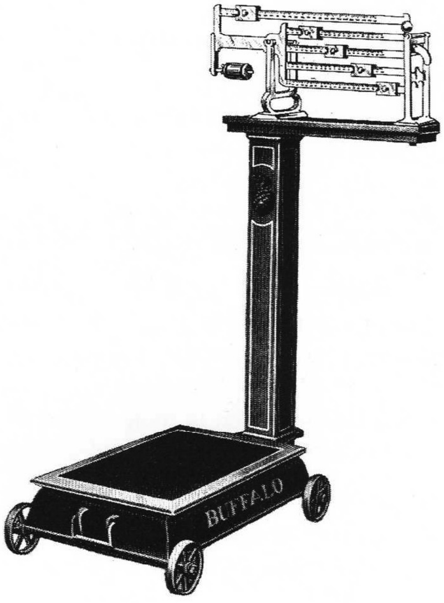


Fig. 26. ▲▲ Beam split into three arms, each with a captive poise on it, the top arm 0-3000 (lb), the middle arm 0-6000 (lb) and the bottom arm 0-500 (lb). The balance ball at the top left can be used to adjust the mechnism finely, or to balance the tare. Combination beam for a platform scale by the Buffalo Scale Co, 1908.

Fig. 27. ►► Beam divided into four arms, and two arms attached to the left end of the beam, one for the balance ball and one for the fractional divisions. Cheese factory scales by Buffalo Scale Co, 1908.



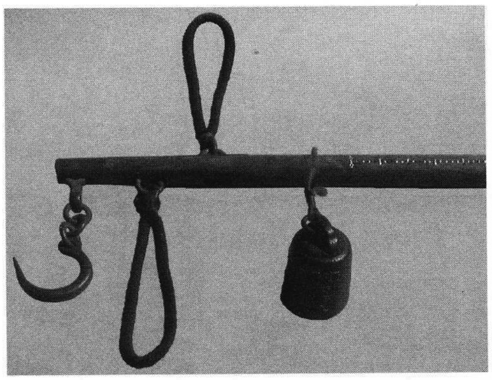
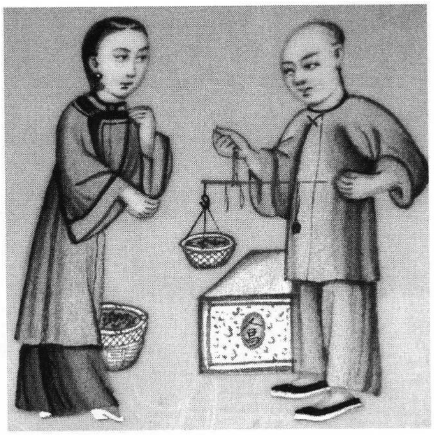


Fig. 28. ≺≺ Japanese dot'chin, 2.5 shaku (2' 6") long. The Japanese liked to use handsome, often purple cords on their dot'chins, and regularly used magnificent thick, plaited cords.

Fig. 29. ≻≻ Japanese steelyard being used to weigh tea-leaves. One of a set of paintings on silk about tea. The man has a dot'chin with three tassels so it must have three sets of graduations. Circa 1890.



Bifurcated beams

The Americans developed steelyards using two hanging poises simultaneously, perhaps one to indicate pounds and one indicate ounces, and continued to use them well into the 20th century. Early 19th-century catalogues showed such steelyards but gradually the bifurcated beam replaced this system. By splitting the beam into two or more parallel prongs, separate poises could fulfil different functions. The main beams were for indicating the mass of the load, but an extra prong might be used to tare the container, and another might hold a balance ball for very fine adjustments. Alternatively, the various prongs might be indicating the amount of each ingredient needed in a mixture - say, flour, yeast, water, sugar and salt.

Turn-over beams

If more than one set of units were required, so that the user could read off (say) in avoirdupois, grams and price, the beam could have a section that swivelled round beyond the fulcrum, so that the load and the fulcrum stayed stationary, but the beam was turned to present different graduations towards the reader. Gibbs patented a Union scale with swivelling beam in 1846. Fairbanks patented a revolving beam for postal use in 1859.

Bent Beams

The beam on a steelyard had not, of necessity, to be straight, but it was much easier to graduate straight beams, and easier to position the pivot of the poise on a straight beam. But makers did occasionally go for the fancy solution! Harris of Philadelphia, USA, kept his beam horizontal, so the poise could be positioned consistently, but bulged the beam out into an arc, so that he could mount the poise on an arm and swing it round the arc.

A French maker had the beam of his trade steelyard undulating, with a snake's head at the end.

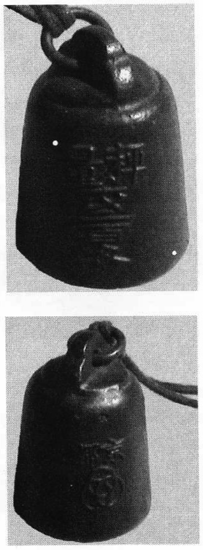


Fig. 30a & b. ≺≺ Poise from a 26ins Japanese dot'chin. Cast iron, cast with the name of the maker and his trade mark. Mass 60 momme. The Japanese were more systematic than the Europeans - they had men who made, under licence, only poises of specific masses, each poise clearly marked with their decorative trade mark.

Graduations

A visitor to China in the early 20th-century, the Rev. A H Smith, wrote that Chinese dot'chins' dots were called stars, and the scale-maker was called the star fixer. The steelyard maker perambulated the streets and put little dots according to the preference of each customer, who would have not less than two balances, one for buying and one for selling.

As with weights for equal-arm scales, the units did not have to be international standard units. The beam of a steelyard could have read-out in pounds per bushel while weighing a gill of grain, pence per postage rate, weight of 12 eggs while weighing one egg, moisture loss after drying timber, percentage of cream in milk, weight of a ream of paper while weighing one sheet of paper, or any other read-out requested by a user.

Compound Steelyards

By hooking several steelyards in tandem, the benefits of each lever can be added together. Very large machines, with a capacity of many tons, were used in heavy industry and on the railroads to weigh steam engines.

Diamond Balances Part 3

BY C SAIT

Imagine the excitement of discovering something that no one else has done. To read about the early experiments in trying to make diamond provides the reader with some insight into that feeling which was achieved by the extremely clever and, in some cases, brave scientists .

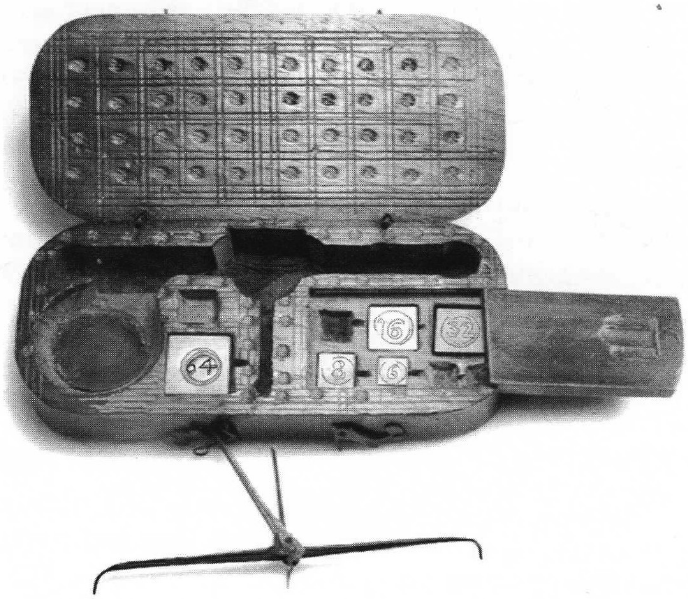


Fig. 19. ▲▲ 0 Possibly the earliest English diamond scale known. The crowned roses stamped on the lid suggest a date of about 1640. Note the thin beam with the turned down hole ends, a very early feature. Half carat to 64 carat weights.

Research started after World War II with the potential market growing at a great rate so the prize was clear but how to achieve the high temperatures and pressures ,without blowing half the world apart, needed to be looked at carefully. Experiments followed unsuccessful experiments in various countries. Failure was the norm and looking over everyone's shoulder were the natural diamond suppliers whose business would be torn apart unless they could do the job themselves and so control the whole thing or buy up those who did achieve what was rapidly becoming the impossible. One example of many was the Hon. Sir Charles Parsons OM, KCB, MA, DSc, FRS. His efforts met with 100% failure. His company however achieved success in a completely different field. He did invent the steam turbine in 1884 for propelling ships. When presented to the Royal Navy for assessment legal technicalities meant that his invention was not incorporated in the ships of the realm. Showing the same tenacity as that to his digression into diamond-making, he sent a ship driven by one of his steam turbines right through the assembled navy at the Diamond Jubilee Fleet Review at 30 knots.

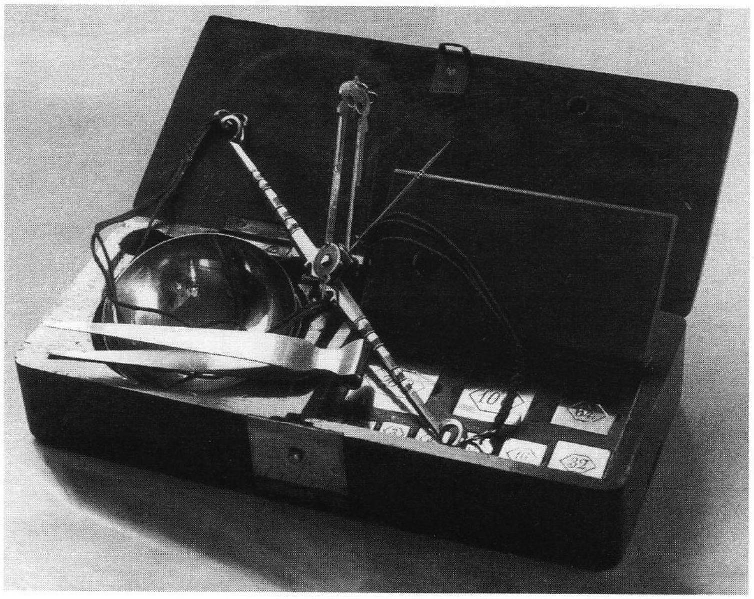


Fig. 20. ◀◀ Diamond dealers were prepared to pay a premium to buy a truly handsome scale. This beauty was probably made by L Exupére of Paris during the second half of the 19th century. The weights go down 200, 100, 64. 32, to 1 carat.

Using the failures as stepping stones, the scientists continued their efforts. Excitement reached fever pitch in the mid-1950s when very small pieces of something were found embedded in one of the pieces of iron making up a press being used for the experiment at General Electric in the US. Money had nearly run out for any further work. The staff were scanning the jobs column when news came back from the laboratory that the iron sample sent away for polishing before examination was ruining their polishing wheel. They were diamonds, not where they expected them, but they had made diamonds!

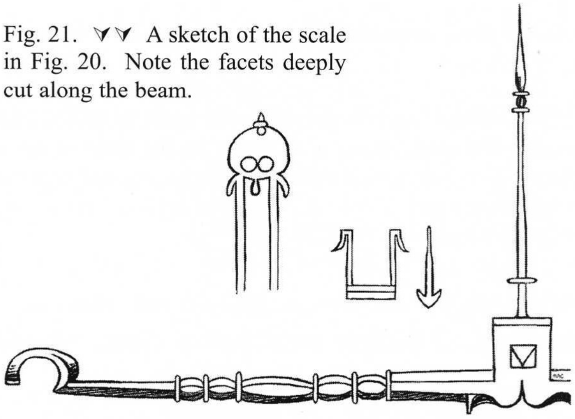


Fig. 21. ▼▼ A sketch of the scale in Fig. 20. Note the facets deeply cut along the beam.

Experiments continued to try and push back the unknown barrier further. Larger and better stones were now a possibility, the field was growing, as was the investment and the excitement worldwide.

A release from the pent-up frustration of the years of failure produced another ingredient - humour. Sitting in his desk one lunchtime one of the scientists, a Bob Wentoff, was eating his lunch. Peanut butter from the left-hand drawer of his desk and crackers. He was fairly well off in his own right but like many others chose a simple fairly non-fat meal. One day, using some of the peanut butter from his jar, he produced diamonds. This kept the eager press busy for a long time and just as the story was beginning to die his boss doubled the length of the news by saying that Bob would have had far more satisfaction if he could have made peanut butter from diamonds.

Many funny stories started to emanate from the various areas of research and about which a whole book could be written. It was not the intention of these articles to throw statistics or technicalities around but one recent quotation sums up the progress over recent years of this phenomenal advancement. *General Electric has synthesised hundreds of tons of synthetic diamonds far exceeding the quantity of all the diamonds mined since Biblical times.* They could never be used as gems but here is one of those interesting things when researching something like this. A new diamond imitation, synthetic moissanite (silicon carbide), is now being produced by C3 Inc. in near colourless form for jewellery purposes. Up until now there is no difinitive method of telling which is what between this material and diamond - quite frightening. All this in the last five years or so.

Another corker which has appeared in this maelstrom of activity. Every school child knows that

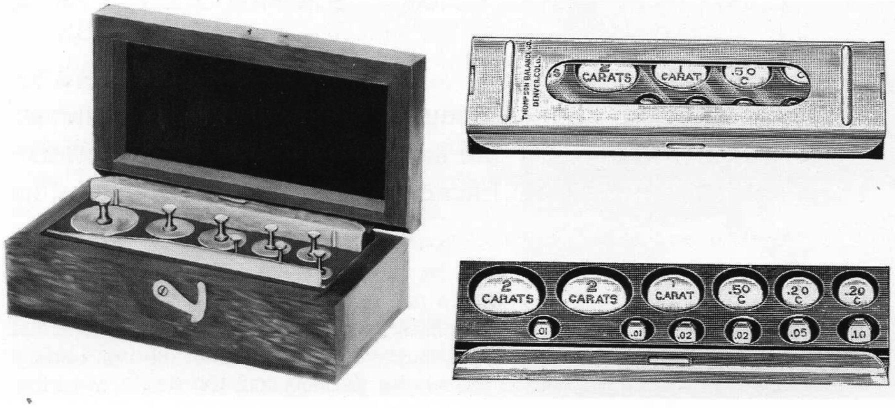
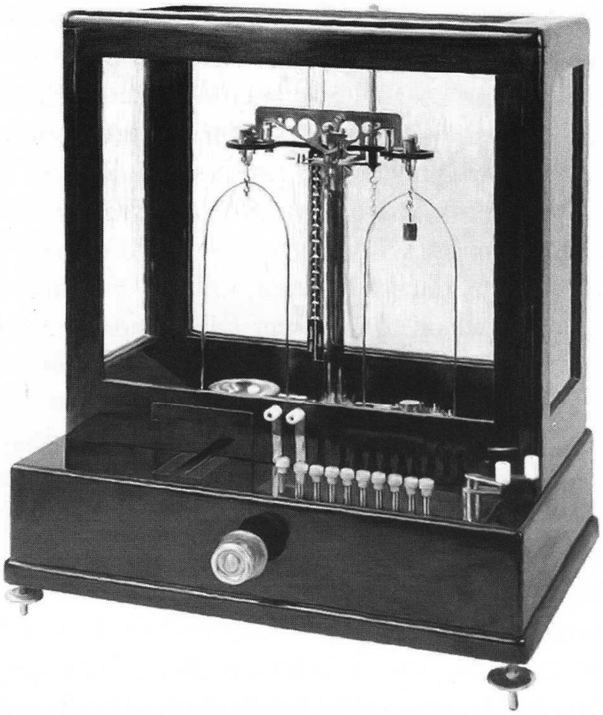


Fig. 22. ◄◄ Thompson Balance Co metric carat weights, with the accuracy of adjustment prescribed by the National Bureau of Standards for Metric Carat weights. The box on the left contains weights 200 carats down, total 501 carats. The safety box, top right, (patented March 20, 1928), has weights 2 carats down, total 6 carats. The paper box contains weights 2 carats down, total 4 carats. Very few companies in USA offered weights for diamonds.

Fig. 23. ➤➤ Diamond balance by Haigis of Onstmettingen, Württemberg, Germany c.1930. Length of beam 140mm. By turning the two cranked levers on the right of the case, the pan came out of the trapdoor, and diamonds could be loaded without opening the case. Pressing a button on the front of the case lowered a rod suspended above the weight-pan, and deposited a weight in the pan. Fine weighing was achieved by raising or lowering the chain. See EQM 493-494.



the hardest substance known to man is the diamond. Nothing scratches a diamond except another diamond. This is still true - sort of. Here we get technical. The diamond dug out of the ground is "Diamond 12"; the scientists can now add another neutron which makes this particular diamond harder. It has something to do with isotope theory which I do not understand either. What about the weight difference?

Let us put the brake on for a while and go back. No mention has yet been made of those gems that have been mined through the ages that are always quoted when talking about diamonds. The Cullinan, the Koh-i-nor and numerous others. To date there are 40 weighing over 100 carats in their polished state. They were all given names and with some there is quite a history. However, let us look for a moment again at the carat. This name is bandied around when talking about these stones but there is a blank stare on many a face when asked they are the metric variety or imperial. If imperial were they weighed in Amsterdam or Bombay? To date I have been unable to get anyone to agree to my dismounting one from the Crown Jewels for checking purposes. If any reader does achieve it, then I do not want to know!

Again a book could be filled with stories of these particular stones. The Cullinan, the largest stone ever mined, was found by a foreman of a mine in South Africa. He was looking around after the shift and found a lump sticking out of the wall of the mine. Thinking it was a joke put there by one of the men, he dug it out and gave it to his boss. At 3106 carats it was found to be genuine and a bonus of $10,000 was given to Mr. Wells who was well-pleased even though the name of the mine owner, Sir Thomas Cullinan, was given to it. It was presented to Edward VII on his 66th birthday, and sent to a Mr Asscher in Amsterdam who examined it for months before he struck the first cut with his cleaving blade. The blade broke. On the second attempt the stone split exactly as planned and Mr. Asscher promptly fainted. It and some of the smaller stones produced are in the crown jewels in the Tower of London.

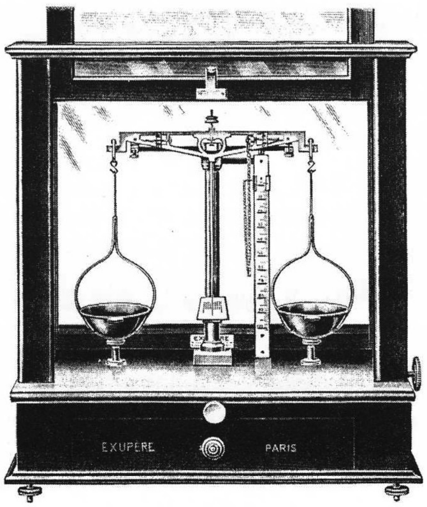


Fig.24. ≺≺ Chain balance by Maison Exupère (Aubry & George), Paris, 1928.

One other story of many concerns the Hope diamond mined in India. Legend has it that it was stolen from a statue of a Hindu goddess. Tavernier, a well known diamond trader between India and France brought it from India and sold it to Louis XIV. On his next trip to India Tavernier was killed and eaten by wild dogs. Louis XIV and Marie Antoinette, the now-owner, were both executed. It was moved on to Wilhelm Fals, a Dutch diamond cutter, who worked on it, but found one day that it was gone. It transpired that, when he learned that his son had stolen it, he died of grief. Hendrick, the son, later committed suicide. Later another owner, an Eastern European prince, gave it to an actress at the Folies Bergère but later shot her. A Greek owner and his family plunged to their deaths over a precipice after a car accident and later Evalyn McLean in 1911 bought the thing. Her son was killed in a car accident, her husband died in a mental hospital and her daughter died from an overdose. It is currently in the Smithsonian Institute in Washington where it is being carefully watched.

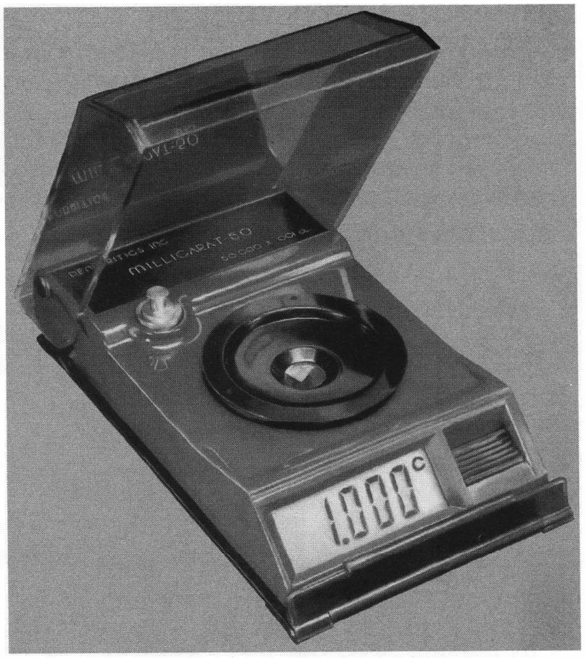


Fig. 25. ▲▲ Diamond scale by Dendritics, Inc. The Millicarat 50 is in production now, at $550. Needs a 9V battery. Weighs from 0.001 carat to 50.5 carats.

We must now turn to the subject that for antique scale collectors is a turn-off. It was mentioned earlier that the fastest method of weighing the vast amount of diamond on the market is the electronic scale. Flip them in to a pan, read a dial, and tip them off, all with an accuracy that could never be dreamed of in the days of the carob seed. The basic structure of the many electronic scales is based on what is known as the Wheatstone Bridge. This is a simple configuration of components which are balanced. Three are identical and the fourth is made from a material that changes its impedance to electricity when it is bent. If the four impedances shown here in schematic form are in balance the indicator gauge reads zero. The variable one is placed under the pan on the scale such that when anything is placed on the pan the unit is stretched altering the current going through it. This produces a voltage drop across the indicator which is calibrated to suit what is being weighed and the weight of the object(s) can be read off. I wish to point out to any electronic scale designers that I am on holiday. Using this method it is possible to weigh human hairs or jumbo-jets.

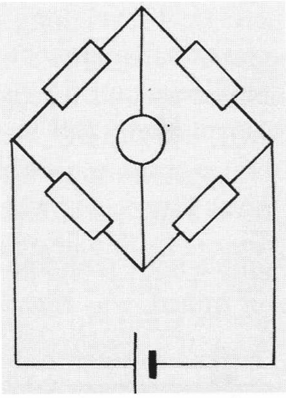


Fig. 26. ▲▲ Diagram showing the layout of the Millicarat 50.

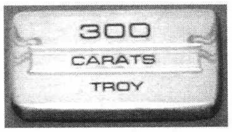


Fig. 27. ▲▲ Where and when was this weight made?

To sum up then we have covered millions of years of history, we have found the ideal occupation to be in, looked into some pretty exciting science and read stories that could be described as bizarre. In between we have tried to keep up with the weighing theme arriving at scales of amazing accuracy suitable for such an expensive product. The story does not end there because currently I am trying to get in touch the General Electric in US on something that throws the foregoing work into turmoil. Reading through one of the many books used in this survey I came upon a photograph of a beaming face looking down on a pile of diamonds, which are falling off the edge of the flat pan of a set of mechanical scales that look as if they had been bought from the local scientific instrument fair.

English Diamond Scale Makers/Retailers

Arnold Engineering Ltd	R C	Croydon & Redhill	1961	Advert in Trade Directory
Avery	William & Thomas	Birmingham	1816-1890	Box in leather pouch. Catalogue shows glass-case
Avery Ltd	W & T	Birmingham	1891-cont.	Ditto in catalogues
Bartlett	Charles	Newcastle	1848-1870	Pocket set
Bastick & Son	Richard	London	1864-1914	Mentioned on trade card
Bastick & Driver		London	1823-1846	Pocket set. Mentioned on trade card
Callipe, Dettmer & Co. Ltd		London	1901-1930	Pocket set. Dealer in jewellers' materials
Day	Wm Chambers	Birmingham	1828-1842	Mentioned on trade card
Day & Millward		Birmingham	1850-1895	Catalogue shows box in leather pouch
Day & Millward Ltd		Birmingham	1896-1940	Catalogue shows glass-case
DeGrave	Charles (I)	London	1780-1799	Pocket set
DeGrave & Co.		London	1845-1905	Glass case
DeGrave & Son	(Mary)	London	1817-1844	Pocket set
DeGrave, Short & Co.		London	1872-1905	Pocket set
DeGrave, Short & Fanner		London	1845-1871	Exhibited at Great Exhibition 1851. Pocket set.
DeGrave	Mary	London	1800-1816	Mentioned on trade card
Driver & Sons		London	1855-1913	Pocket set
Freeman	Samuel (II)	London	1716-1757	Mentioned on trade card. Pocket set
Herbertz	John Wilhelm	London	1763-1779	Large boxed set
Kirk	John	London	1725-1761	Mentioned on trade card
Koritschoner	David	London	1888-1905	Glass-cased
Lamb	Percivall	London	died 1725	Mentioned in inventory
Lewis	William	London	1758-1762	Pocket set
Lewis & Nicholl		London	late 18th c.	Pocket set
Lind	John	London	1729-1783	Mentioned on trade card
Neale	Samuel	London	1644-1690	Pocket set
Oertling	Ludwig	London	1870-1919	Catalogue shows glass-case
Oertling Ltd.	Ludwig	London	1919-1970	Mentioned in Trade Marks Journal
Overing	Thomas	London	1717-1731	Mentioned on trade card. Pocket set *
Partridge	John	London	1796-1799	Pocket set
Phillips	Walter	London	1701-1719	Pocket set
Read	Samuel	London	1735-1779	Mentioned on trade card. Pocket set
Roberts	Richard	London	1744-1749	Pocket set *
Roberts	Timothy	London	1693-1731	Pocket set
Roberts & Son	Timothy	London	1731-1744	Pocket set
Rook & Sons		London	c.1910	Pocket set
Snart (1st)	John	London	1693-1731	Pocket set
Sommers & Son		London	1784-1808	Mentioned on trade card
Vandome, Titfords & Co.	Richard	London	1841-1863	Pocket set
Vandome, Titfords & Pawson		London	1866-1898	Pocket set
Vincent	Robert (I)	London	1751-1795	Mentioned on trade card
Walsh Bros				
Webb	Richard William	London	1831-1871	Mentioned on trade card
Williams	Thomas	London	1776-1835	Pocket set
Young	John (I)	London	1802-1810	Pocket set

*. Tweezers without a shovel.

US Patents 1866 - 1870

Text by R. HENDRICKS WILLARD

Captions by D. CRAWFORTH-HITCHINS

With the outbreak of the Civil War, all the federal buildings in the South were commandeered for the use of the Confederacy. As early as May 21, 1861, even before before Virginia and Tennessee seceded from the United States, Jefferson Davis sent a message to the Confederate Congress recommending the immediate establishment of a Patent Office, as the government was already receiving some 70 applications a month. The office, located in the prestigious Mechanic's Institute Building in Richmond, was opened in July, and Confederate Patent No. 1 was issued on Aug. 1. A large hall was fitted-out with glass-doored cabinets to allow the exhibition and inspection of patented models. Most of the 266 known Confederate patents related to devices for aiding the war effort. No scale patents have been found. The South's most famous patent is No. 100, issued to John Mercer Brooke for the design of the ironclad ship Merrimac. On April 3, 1865, a warehouse fire set by the fleeing Confederate troops to keep supplies from falling into Union hands destroyed much of central Richmond, including the Patent Office.

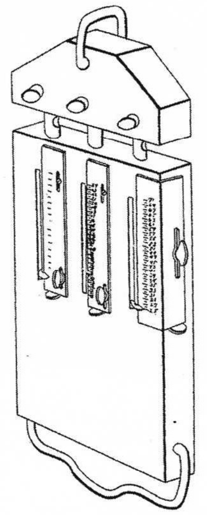


Fig. 1. ◄◄ No. 54,941 of May 22, 1866. O'Neil placed 3 springs in line, so that one could be used alone to weigh small amounts, 2 together weighed twice as much and 3 together weighed three times as much.

That history is remarkably similar to the early days of the US Patent Office. The new nation's first patent statute, passed by Congress of the *twelve* United States, became law on April 10. 1790--49 days before Rhode Island ratified the Constitution. Patented models were displayed in a large hall for public examination When the US Patent Office was burned out in 1836, nearly all the 10,000 patents and models were destroyed. Some were later reconstructed from other records.

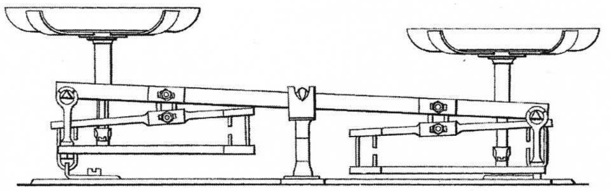


Fig. 2. ▲▲ No. 56,940 of Aug 7, 1866. Hoffman's top-pan counter scale has novel links under the pans, a modified version of beranger scale. The bearings nearer the fulcrum are adjustable, so manufacture was simplified.

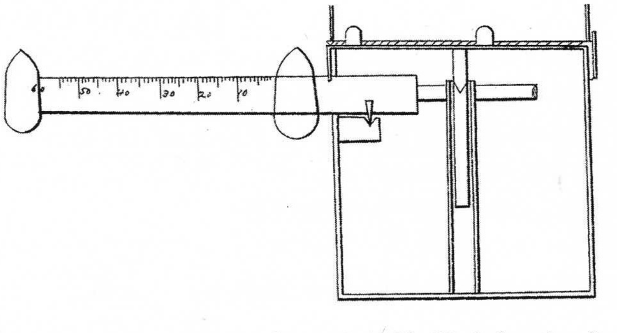


Fig. 3. ▲▲ No. 59,213 of Oct 30, 1866. Haak thought of a steelyard with a ring pressing down on it. The bucket slides in the ring and the vertical tubes. He patented a spring that was flicked against the bucket to settle the contents and a swiveling strike.

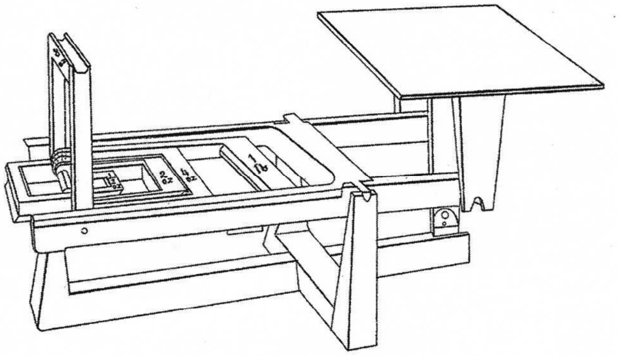


Fig. 4. ▲▲ No. 60,184 of Dec 4, 1866. Harris' wording is very difficult to understand, but he is probably patenting flip over poises on the end of the double beams of a counter steelyard.

But there was one striking difference in the two patent systems. Two governments went to war over the issue of slavery. Only one of them allowed slaves to receive patents for their inventions. That one was the South.

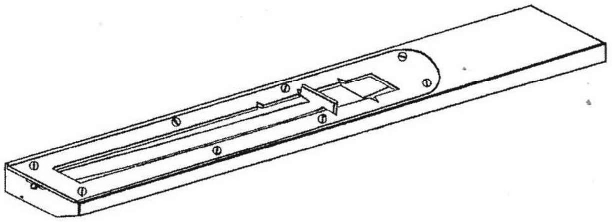


Fig. 5. ▲▲ No. 69,948 of Oct 15, 1867. Taylor made a simple wooden rule with a slot cut in the upper surface. The slot held a long spring, along which a poise moved. The fulcrum position was marked on the rule, and the user put the mark in line with the edge of the table so that the rule rocked. A letter was held by a pin at the end of the rule. Example known.

The end of the Civil War in mid-1865 unleashed a hoard of eager inventors. In that year the number of applications was 40% greater than in any preceding year, and the number of patents granted was nearly double that of 1861. But the officials were faced with a dilemma. Were citizens of the states recently in rebellion entitled to take out patents as formerly? The Patent Commissioner wrote to the Secretary of the Interior, who consulted President Johnson, who replied that each such resident must furnish an original or authenticated copy of the prescribed amnesty oath to the Patent Office before a patent could be issued, and if the applicant was in the "excluded classes" such as a former officer of the Confederate government, he must also provide evidence of a special pardon by the President.

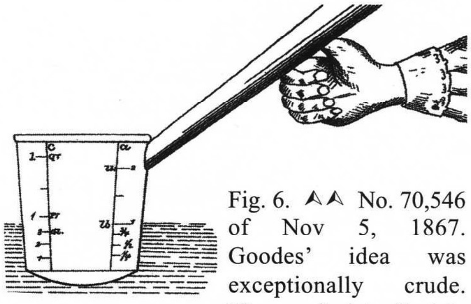


Fig. 6. ▲▲ No. 70,546 of Nov 5, 1867. Goodes' idea was exceptionally crude. The cup had to float in water, with the handle lightly supported by the user. The graduations had to be read at the surface of the water!!

These years saw a proliferation of specialty scales. Steelyards still predominated, but they might be equipped with cannonball weights or incorporated with a butter stamp, an ink stand, or a refrigerator, or adapted to indicate the moisture loss in roasting coffee. Pendulum scales, often with dials, were becoming much more popular. Americans were gaining confidence in spring scales. These were often used on weighing scoops, hay forks, beer measures, top-pan counter scales, candlestick scales, and even a chondrometer. Inventors were preoccupied with price-computing scales, which they adapted to every mechanism.

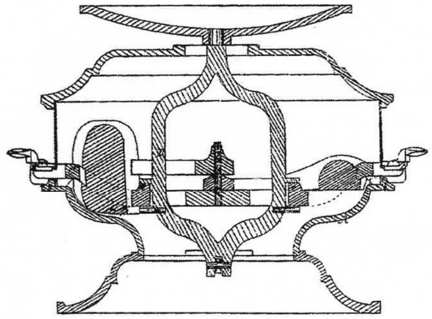


Fig. 7. ▲▲ No. 72,615 of Dec 24, 1867. Eddy's diagram shows the innards of a disc-shaped counter scale. The user pulled on the tabs each side of the disc, swiveling the poises (hidden in the disc) towards the user.

Fig. 8. ➤➤ No. 72,864 of Dec 31, 1867. Lake devised a most interesting poise, shaped like a price-indicating fan with cogs below the fan. The poise was moved by the user pulling on the handle sticking up above the fan.

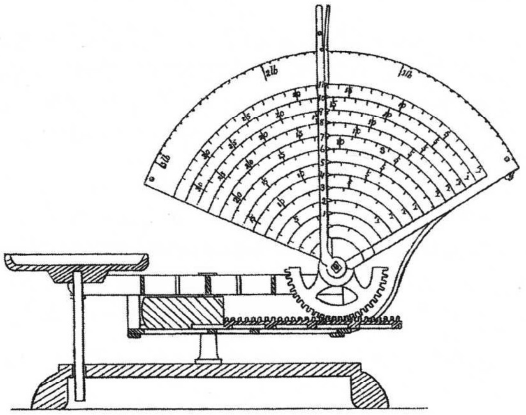
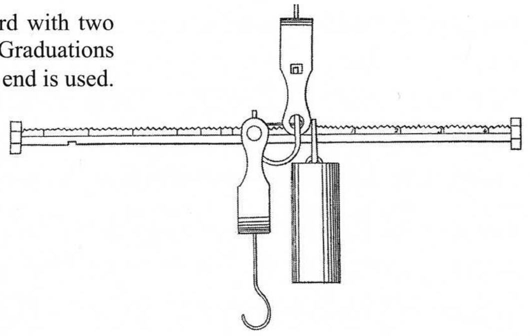


Fig. 9. ➤➤ No. 81,388 of Aug 25, 1868. Maranville patented a steelyard with two fulcra. Graduations for lighter loads face the user as shown in the drawing. Graduations for heavier loads are on the back of the beam, when the fulcrum near the left end is used.



From 1790 until 1866, two manuscript copies were made of the specifications for each patent, one to be affixed to the issued patent, and one for the office record. Impoverished genteel young ladies were usually employed to do this work at home. They were paid 10 cents per 100 words copied. Later, about 65 female copyists were employed to work within the Patent Office building at a salary of $700 per year. When it was found that their work was fully equivalent in quality to that of the male clerks doing the same work at $900 per year, the number of male clerks was reduced and the Patent Commissioner recommended equal pay for equal work. In November, 1866, the Patent Office began printing ten copies of the specifications for each patent as issued. Free copies were given to the examiners and to the British Patent Office, which in return gave the US office copies of their entire issue of patents. The extra copies could be sold to the attorneys and the public. The volume of work continued to escalate. In 1867, 13,015 patents were issued in a 46-*week* period--30% more than the 10,000 issued in the first 46 *years* and burned in 1836.

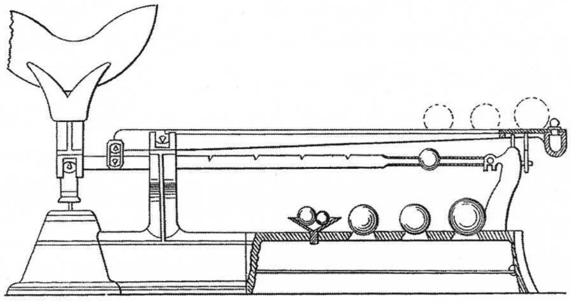
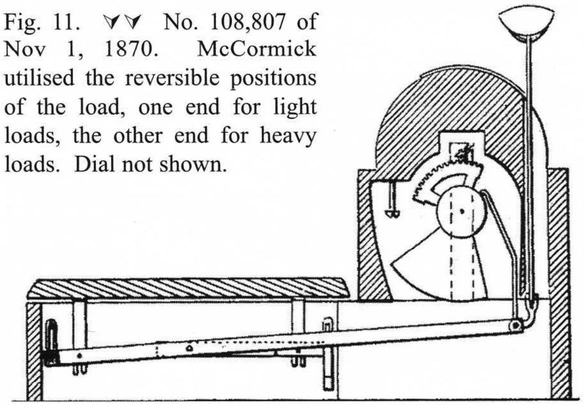


Fig. 10. ▲▲ No. 99,148 of Jan 25, 1870. Buoy shows his more complicated version, with one $1^{1}/_{2}$lb ball, and two 1lb balls, to use in the upper holes (allowing weighing of 1lb - 25lb) and with a 1oz ball and a 2oz ball, to use in the lower holes, (allowing weighing of 1/2oz-47oz). The simpler version had balls of only one weight, as shown on page 2685 and on most versions found today.

Hand-drawn copies of the drawings from a patent, where required, cost from $10 to $100. An 1869 proposal to appropriate money for the Patent Office to lithograph the drawings of issued patents was defeated. But by 1870 photolithography had developed to the point where photographic copies of patents could be printed for about four cents per copy. On January 11, 1871, Congress passed a joint resolution supporting such publication and free distribution to each state.

Fig. 11. ▼▼ No. 108,807 of Nov 1, 1870. McCormick utilised the reversible positions of the load, one end for light loads, the other end for heavy loads. Dial not shown.



The information in this article is extracted from the book *The Patent Office Pony, a History of the Early Patent Office* by Kenneth W. Dobyns. To view the entire book on the internet, visit http://www.myoutbox.net/pohome.htm

With thanks to Norman Cima for entering the scrambled citations in the *Subject Index* in an excel file; to Steven Beare for sharing the list he obtained through a professional search sevice, and to Diana Crawforth-Hitchins for downloading and interpreting the patents from the website http.//www.USPTO.gov

The writer will be happy to email the Excel table to any reader requesting it and to provide hard copies sorted by inventor, residence or mechanism to members who do not have email.

Patents sorted by date (shop/warehouse platform scales and smaller) 1866-1870

NO	DATE	INVENTOR	RESIDENCE	ASSIGNEE	TYPE
53,020	Mar 6, 1866	A Y McDonald	Dubuque, IA		Pendulum counter sc
53,050	Mar. 6, 1866	L Shepherd	Gold Hill, NV		Pendulum counter sc
53,327	Mar 20, 1866	J K O'Neil	Kingston, NY		Spring wg scoop
54,007	Apr 17, 1866	J K O'Neil	Kingston, NY		Spring hay-fork
54,435	May 1, 1866	J B Stewart	South Paris, ME		Spring hay-fork
54,509	May 8, 1866	H S Cushing	Blossburgh, PA		Rotating price chart on steelyard
54,841	May 22, 1866	J K O'Neil	Kingston, NY		3 springs, separate or conjoined
55,117	May 29, 1866	J King Jr.	Fort Wayne, IN		Pendulum counter sc
55,503	June 12, 1866	J S & E B Lake	Smith's Landing & Bridgeport, NJ		Computing pend. counter sc
55,961	June 26, 1866	F M Strong & T Ross	Brandon, VT		Lever & shaft under platform sc
56,547	July 24, 1866	T T Fowler	Washington, DC		Steelyard on ice cart
56,940	Aug. 7, 1866	C E Hoffman	Jersey City, NJ		Adjustable beranger type counter sc
57,097	Aug 14, 1866	J Dailey	Albany, NY		Spring under 5 pint beer measure
57,332	Aug. 21, 1866	J Johnson	Saco, ME		Price indicating spring balance
2,341R	Aug 21, 1866	R Shaler	Madison, CT	Reissue	Spring-top coumter sc
57,364	Aug 21, 1866	R Murdoch	Baltimore MD		Graduations on top of steelyard beam
57,921	Sept. 11, 1866	J F Keeler	Pittsburgh PA		Graduated hanger & poise split to tare
59,213	Oct 30, 1866	H Haak	Myerstown, PA		Chondrometer
60,184	Dec 4, 1866	S Harris	Philadelphia, PA	C T Murphy	Wt-lifting counter sc
60,858	Jan 1, 1867	B Churchill	Wareham, MA		Divided steelyard
64,686	May 14, 1867	F Meyer	Newark, NJ		
66,165	June 25, 1867	J W Neal & W H Startzman	Big Lick, VA	selves & H Munnikhuysen	Cam & cord turning dial, on counter sc
66,524	July 9, 1867	R Shaler	Madison, CT		Flexure spring top-pan counter sc
66,533	Jul 9, 1867	W A Starratt	Boston, MA		Buffer on steelyard
66,722	July 16, 1867	C C Lyman	Edinboro, PA		Inclined plane on platform sc
66,825	July 16, 1867	L H Franklin	Poland, NY		Pendulous case & steelyard
67,274	July 30, 1867	A B Davis	Philadelphia, PA		Stops on divided steelyard
67,349	July 30, 1867	W W Reynolds	Brandon, VT	Howe Scale Co	Center wt-holder on counter roberval
67,454	Aug. 6, 1867	S E Robbins	Boston, MA	Elmer Townsend	Bearings with no lateral movement
67,596	Aug. 6, 1867	L M Severance	Dixon, IL		Levers uinder platform sc
67,871	Aug. 20, 1867	W P Goolman.	Dublin, IN		Poise & levers on platform sc
67,908	Aug. 20, 1867	W W Reynolds	Brandon, VT	Howe Scale Co	Links joining bearings under platform
68,490	Sept. 3, 1867	E P Crain	New York, NY		Brace to prevent steelyard's dropping
68,728	Sept. 10 1867	C E Gage	Fond du Lac, WI		Bag attachment for steelyard
69,691	Oct. 8, 1867	F Meyer	Newark, NJ		Scoop
69,774	Oct. 15, 1867	S W Cox	New Haven, CT		Flexure spring letter sc
69,948	Oct 15, 1867	J G Taylor	Lawrenceville, NY		Rule with poise inside for wg' letters
70,531	Nov. 5, 1867	H W Comstock	La Fayette, IN		Glass weights
70,546	Nov 5, 1867	E A Goodes	Philadelphia, PA	self, E L Miller & W H Morford	Hydraulic Measuring Cup
70,942	Nov. 19, 1867	J Benham	McClean, NY	I & A B Benham	Proportional sc for 2 ingredients
71,588	Dec. 3, 1867	J C Dell	Philadelphia, PA		Union Sc
71,980	Dec. 19, 1867	J. Chatillon	New York, NY		Case for spring bal
72,037	Dec. 10, 1867	D Hazard	Milton, DE		Candlestick sc with graduations on stand
72,593	Dec. 24, 1867	I. Bisbee	Richmond, MO		Disk graduated to weigh troy, apoth, avoir, also letters, US & foreign coins
72,615	Dec. 24, 1867	L Eddy	Taunton, MA		Swiveling poises
72,864	Dec. 31, 1867	E.B Lake	Bridgeport, NJ		Lever-operated poise with fan
73,273	Jan. 14, 1868	J D Willoughby	Shippensburgh, PA		Spring damper on roberval counter sc
73,356	Jan 14, 1868	B Martin	Prairie du Chien, WI		Spring chondrometer
73,976	Feb. 4, 1868	M L M Hussey	New York, NY		Spring letter sc with revolving dial
74,624	Feb 18, 1868	G A Smythe	Reading PA		Price indicating steelyard

75,146	Mar. 3, 1868	O.Forsyth & J H Truex	Rochester, NY		Notched beam on large steelyard
75,244	Mar 10, 1868	B Chambers Jr.	Washington, DC		Knife edges in steelyard postal sc
75,448	Mar. 10, 1868	R Murdock	Baltimore, MD		Folding pan on spring bal
76,523	Apr. 7, 1868	W W Reynolds	Brandon, VT	Howe Scale Co	Yoke & wheels for platform sc
76,628	Apr. 14, 1868	H M Hervey	Madison, OH		Jack/teelyard to weigh wagons
78,532	Jun 2, 1868	L A Matos	Philadelphia, PA		Poise pulled round arc horizontally on counter steelyard
78,604	Jun 2, 1868	J K O'Neil	Kingston, NY		Spring weighing scoop
80,003	Jul 14, 1868	B W Ogburn	Whittle's Mills, VA		Calculating steelyard used both ends
80,169	Jul 24, 1868	S Harris	Philadelphia, PA		Pend sc with arc
80,857	Aug 8, 1868	J Decker	Sparta, NY	J B Boss & C C Clark	Spring platform sc
81,388	Aug 25, 1868	H Maranville	Akron, OH		2 fulcra steelyard
82,477	Sep 29, 1868	J L & G Babson	Rockport, MA		Counter pendulum sc with dial
82,842	Oct 6, 1868	A B Hurd	Watkins, NY		Spring wg-scoop
85,816	Jan 12, 1869	S S Hamilton	Taylor's Falls, MA		Pendulum counter scale
88,442	Mar 30, 1869	I Buckman, Jr	Williamsburg, NY		Steelyard in a refrigerator !
89,862	May 11, 1869	J G Dyer	Chicago, IL		Pendulum counter sc with dial
91,553	Jun 22, 1869	C Mackh	Elgin, IL		Counter steelyd used to indicate moisture loss in roasting coffee
93,054	Jul 27, 1869	G W Chandler	Fitchburg, M	self & J G Folsom	Pendulum scale
93,720	Aug 17, 1869	R B Keppner	Philadelphia, PA		Steelyard letter sc & pen
94,292	Aug 31, 1869	J Decker	Sparta, NJ	self & E De Camp	Shelf-edge household scale
94,517	Sep 7, 1869	L M Severance	Dixon, IL		Lever connections w rod on platform sc
94,755	Sep 14, 1869	R G Kimball	Albany, NY		Rolling fulcra on pendulum counter sc
94,925	Sep 14, 1869	W. F. Sweet	Jackson, PA		Computing steelyard
94,974	Sep 21 1869	D H Priest &	Watertown &		Spring wg scoop
95,588	Oct 5, 1869	S Ingersoll	Brooklyn, NY		Exposed spring sc
96,673	Nov 9, 1869	W T Carlile	New York, NY		Ink stand, cover also letter steelyard
96,955	Nov 16, 1869	W P Pierce	New York, NY		Screw-point fulcra
97,053	Nov 28, 1869	J S Corya	Dupont, IN		Butter stamp & steelyard
97,119	Nov 23, 1869	C Renne & F Landenberger	New York, NY		Weighing basket
97,839	Dec 14, 1869	P H Walker	Boston, MA		Swiveling poise round turn-over steelyd
98,453	Dec 28, 1869	C H Wight	Baltimore MD		Desk set with candlestickletter balance
99,148	Jan 25, 1870	D Buoy	Danville, PA		Counter steelyard with ball poises
99,326	Feb 1 1870	H D Lathrop &	Bedford, OH		Computing revolving steelyard
100,066	Feb 22, 1870	W B Preston	North Chelsea, MA		Swiveling poise-hanger on t/o steelyard
102,792	May 10, 1870	T Fairbanks	St Johnsbury, Vt		Multiple beam platform sc
103,478	May 24, 1870	C C Lyman	Edinborough, PA		Recording platform sc w arrestment
103,541	May 31, 1870	A Assmann	Rahway, NJ		Pendulum counter sc
103,977	Jun 7, 1870	S R P Camp	New York, NY		Rolling apron of prices on spring bal
104,160	Jun 14, 1870	J Jochum	Brooklyn, NY		Springy bottom to pointer
104,499	Jun 21, 1870	G S Rice	New York, NY	Vulcanite Jewelry Co	Mini spring bal with heart-shaped clip
106,163	Aug 9, 1870	W S How	Cincinnati, OH		Fine bullion & drug steelyard
106,560	Aug 23, 1870	G W Dickinson	Charleston, IL		Disc & cord pendulum w loose-wt poise
106,869	Aug 30, 1870	W H Phinney	Pawtucket, RI		Computing spring balance
107,182	Sep 6, 1870	G W King	Georgetown, DC		Weight lifting counter steelyard
107,272	Sep 13, 1870	J V Mathivat	Cleveland, OH		2 pointers working independently on counter spring balance
108,807	Nov 1, 1870	W H McCormick	Muncie, IN	W H McCormick & J T Williams	Pend platform w reverse wg for tiny amounts*
110,261	Dec 20, 1870	R J McKeone	Inverness, MI		Double pend platform sc

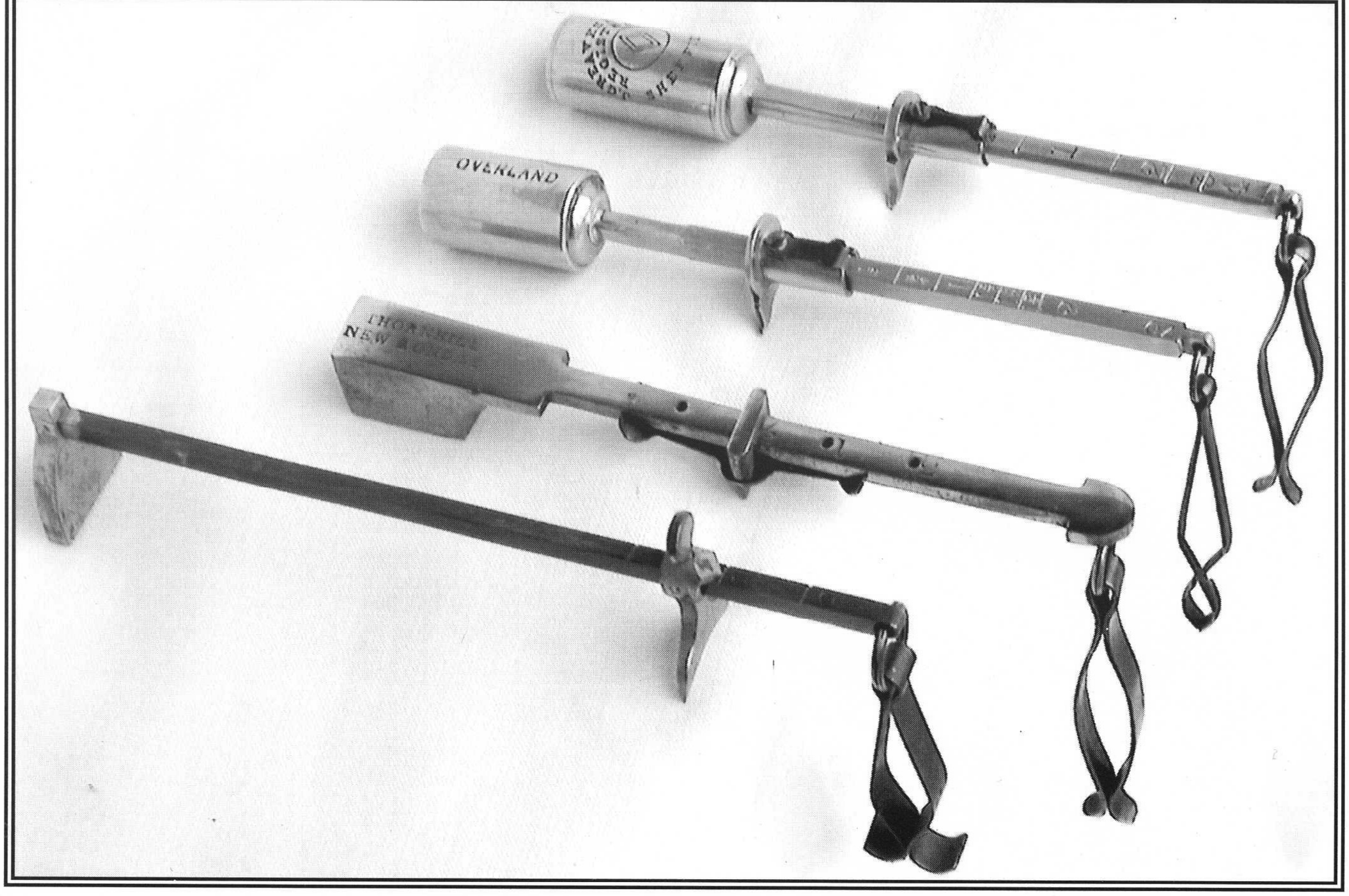
ISASC

EQUILIBRIUM®

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

2002—ISSUE NO.3

PAGES 2701-2728



Cover Picture

Each bismar was contained in a leather cap-end case that fitted easily into a travelling desk or into a pocket. From left front, (1) HOOPER'S POCKET LETTER WEIGHT, REG GB 2 VIC C 17. This reference to the new Design Registration system was given added legal authority by referring to it via its Act of Parliament that was passed in the second year of the reign of Queen Victoria, [1839] Chapter 17. The screw on top of the fulcrum legs enabled the user to set the bismar at $^{1}/2$oz, the bottom rate, unless a heavy letter of 1 or 2oz was to be checked. Made of gilt iron, with blued steel clip. (2) THORNHILL NEW BOND ST [London] put a flat spring with turned up ends beneath the beam. When the user desired to change the weight being checked, he pressed the spring up against the beam, loosening the ends of the spring, so that the fulcrum would slip along the beam. Made of polished steel. (3) EDWARD GREAVES bismar for the Indian Colonial Post. One side, OVERLAND [to India] marked $^{1}/4$, $^{1}/2$, $^{3}/4$, 1, 1$^{1}/4$, 1$^{1}/2$, 1$^{3}/4$, 2, [oz] and, on the reverse, INDIAN [from India] $^{1}/4$, $^{1}/2$, 1, 1$^{1}/2$, 2, 3, 4 [presumably the price of a stamp in tolas]. This rare turn-over bismar has a revolving saddle that can only revolve when the saddle is pushed right up against the poise. Made of nickel alloy [German silver] with blued steel spring and clip. Retailed by H Rodrigues, 42 Piccadilly. (4) J GREAVES & SON, REGISTERED, SHEFFIELD. For the half-sovereign, sovereign, $^{1}/2$, 1, 2, 3, 4 [oz letters]. Also nickel alloy with blued steel spring and clip.

ISASC

INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

EQUILIBRIUM is published quarterly in January, April, July and October
© 2001 International Society of Antique Scale Collectors ISSN-0893-2883

International Society of Antique Scale Collectors
Founded September 1976
Internal Revenue Service 501 (c) (3) EIN 36-2976411
3616 Noakes St., Los Angeles, 90023
Tel 323.263.6878 **Fax** 323.263.3147
www.isasc.org Thomas_Dooley@bbs.macnexus.org

Directors and Officers 2001*

President. .Thomas Dooley*
Vice Presidents. . . . . Steven Beare*
. . . . Jerome Katz*
. . . . Ruth Hendricks Willard*
. . . . Gerald Wilson*
Secretary . . . . Norman Cima*
Treasurer. . . . . Edward Konowitz*
Executive Secretary . . . . .Jan Macho
President Emeritus. . . . . Bob Stein

For membership information contact
Steven Beare stevebooks@aol.com
7 East Brookland Avenue, Wilmington, DE 19805

Published with the co-operation and support of

ISASC Europe
Founded October 1993
CHARITY COMMISSIONERS FOR ENGLAND & WALES NO 1037558
P.O. Box 179, Headington D.O. Oxford OX3 9YP

Trustees and Officers 2000-2002*

Chairman . . . . .John Cheeseman
Treasurer . . . .Ken Govier*
Secretary. Phil Holroyd*
European Representative . . . . . .Serge Camilleri
Meetings Secretary . . . . Janet Scarratt*
Publications Officer . . . . Roy Ladell
Trustee . . . . Brian Stimpson*
Information Officer. . . . ..D Crawforth-Hitchins

For membership information contact
P.O. Box 179, Headington D.O. Oxford, OX3 9YP, UK

Editor: Diana Crawforth-Hitchins, **Tel** +01865 763096 **Fax** 01865 751797 les.hitchins@bcs.org.uk
Associate Editor: Ruth Hendricks Willard, **Tel** 415.566.9670 **Fax** 415.566.3666 rhwillard@aol.com

Joel F Keeler, Epitome of US Industry

BY C PETERSON, D GARDINER and D CRAWFORTH-HITCHINS

Editor - The ISASC Convention of 2002 was arranged for Pittsburgh. My mind went back 45 years to a vibrant book that I read, a novel with 19th-century Pittsburgh as the backdrop to the lives of a family of Hungarian immigrants. I imagined the furnaces, the railroads, the coal-tips, the manufacturing plant, all the rugged, filthy, dollar-earning hive of industry that was Pittsburgh. I had those immigrants deeply embedded in my psyche. I cared about them, wept with them, rejoiced with them. I wanted to see the throbbing city of industry. I was amazed to drive into a pretty, tree-lined valley, with colourful houses ranged up the hillsides, winding rivers with no sign of pollution, and a city-centre of considerable beauty. Where had the vigour gone? It has been diverted into cultural events and civic pride. Was I disappointed? Yes, in one way, but no, not when thinking about the comfortable lives those immigrants' descendants lead now.

We have to go to Cleveland, OH, to find the roots of Joel F Keeler. Born in 1819, by 1853 Joel F Keeler lived in Ohio City, and worked at his Forest City Scale Works, Vineyard St. (Ohio City is on the west bank of the Cuyahoga River. Cleveland is on the east bank. The two cities became one in about 1855. Ohio City is the older part of town.)

Joel felt strongly about improving his home-town, writing three letters to the editor of his local newspaper, the *Daily True Democrat*, about temperance. Joel was a member of a Temperance organisation, and became a delegate from the 2nd Ward of Cleveland in 1854. He was recorded as a *large scale manufacturer*, and, in March, 1855 was nominated for City Sealer. That suggests that he had a reputation for probity, this being reinforced by his nomination as County Treasurer in September, 1855.

The first patent, 11,729, of Sept 26, 1854, was taken out when Joel was living in Cleveland. He designed a platform scale for weighing freight of hundreds of pounds per load. He devised a system of levers that raised and lowered the platform after it had been loaded, yet make the bearings drop neatly onto the knives without causing unequal wear. He coupled this idea with a second system to enable the user to weigh *with celerity, rather than extreme accuracy*, large numbers of virtually identical loads (barrels, boxes, etc) without moving the poise each time. The user put one box on the platform, and moved the poise until the indicator was located mid-way up the tube on the right. The poise gave the true weight. The indicator was attached to a spring balance, used only for comparisons. If a heavier box was put on the platform next, the spring balance was stretched more than for the previous box, and read off on the graduations on the tube, that, say, the box was 10lb heavier. Then maybe a lighter box was

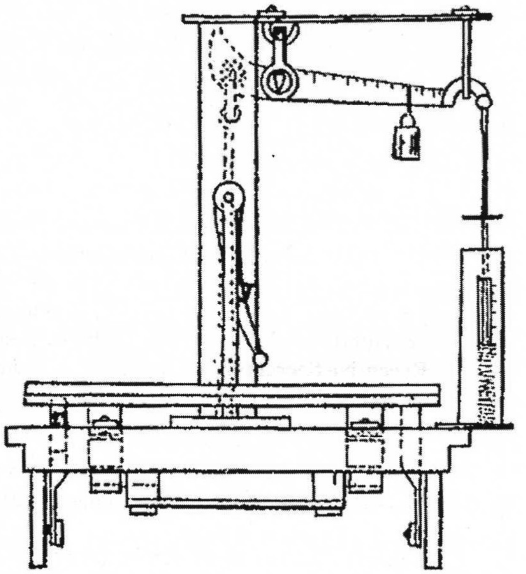


Fig. 1. ▲▲ The first patent, 11,729, of Sept 26, 1854

put on the platform. The poise still was not moved, but the spring was less stretched, and the graduations indicated that this box was 5lb lighter than the first box. If the user didn't want to compare each load, he simply disconnected the spring balance and used the platform scale in the conventional way.

In 1856 Joel was the City Sealer as well as being a manufacturer of scales. He was living on Euclid Avenue. (Euclid Avenue became one of the best addresses in Cleveland for much of the 1870-1900 period. John D Rockefeller was living at 474 Euclid Avenue in 1871.) His reputation for probity must have been maintained, as he was on the Cleveland Manufacturing Committee by May 1856, and was made secretary of the Republican Party.

By 1858, Joel was a scale manufacturer at Vineyard near Superior and Bennett House Block, and he boarded at Bennet House. (Superior is the main street of downtown Cleveland.) As he was boarding, he was very probably not married. He was, however, still thinking about manufacturing improvements, this time to door springs, patenting one in August, 1858.

The second scale patent, 20,492 of Jun 8, 1858, is for a somewhat similar idea to his first, but indicating the whole load's weight on a pendulum scale if desired. Keeler suggests *When the quantities to be weighed are not given, or fixed, as is usually the case in weighing loaded wheelbarrows and other vehicles, then the weight can generally be ascertained on a self-indicating scale by a single trial.* Again, the mechanism could be detached if the user wanted to use the platform scale conventionally, he suggests *any given fixed weight such as 100 bushels of wheat, or 40lb of sugar, can be most speedily weighed by the ordinary platform scale, since the beam will rise at the moment when the requisite quantity has been placed on the scale, provided the proper poises had previously been placed on the beam.* But, being Keeler, he doesn't just patent one idea. Again, he slips in another idea, the use of a swivelling spirit level and a plumb-line, to enable the user to place his platform scale in a level position, a pre-requisite for using pendulum scales accurately.

In May, 1859, Joel announced an anti-slavery meeting, and wrote to the *Cleveland Leader* about John Brown. His temperance, his public work and his active attempts to abolish slavery all suggest a man of strong moral beliefs.

By 1860 Joel still had his Forest City Scale Works, at 7 West near Merwin, Cleveland. The census taken in 1860 recorded Joel, aged 41, as a scale manufacturer with real estate valued at $1000, but his place of birth was not known. Joel was still fizzing with ideas, patenting a clock adjuster in 1860.

By 1861 Joel was a scale manufacturer, still boarding at Bennett House at 41 Public Square. (Public Square is the center of downtown

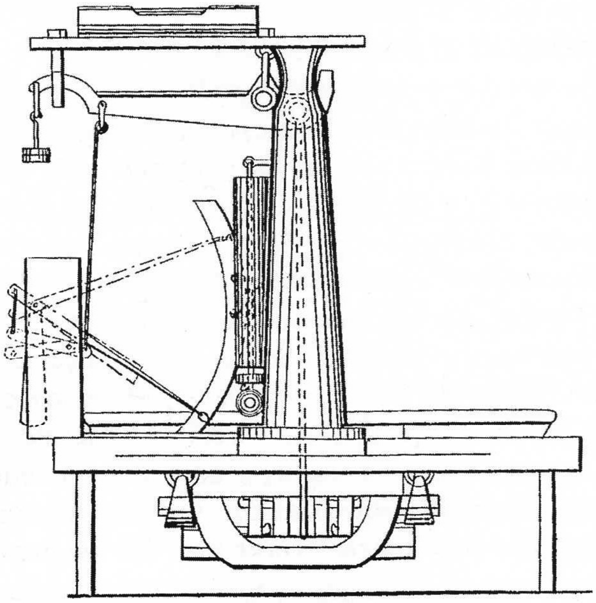


Fig. 2. ▲▲ Patent no. 20,492 of Jun 8, 1858

Cleveland. In the early 1800s it was the town/village green where the cattle were grazed in common.)

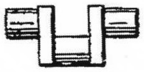


Fig. 3. Patent no. 43,511 of July 12, 1864

Both these platform scales invented in Cleveland, OH, suggest that he was making middling-sized platform scales for industrial use. When he moved to Pittsburgh by 1863, opening a second office, he was listed in the City Directories as a scale maker on 4th Avenue in downtown Pittsburgh. He lived in middle-class areas in Pittsburgh for the rest of his life.

When he patented no. 43,511 of July 12, 1864, he was thinking about economical ways of making platform scales. He patented a T-form for the levers under the platform, using two cheap wrought-iron bars held together by tabs (he called them knees) instead of thick steel bars. This economy probably enabled him to undercut the prices charged by Fairbanks, who had to ship the steel levers over the mountains from the east.

He moved to 2nd Avenue, Pittsburgh in 1866, and on Sep 11, 1866, took out patent number 57,921. This time he referred to taring the *weight of Cars or other vehicles* and determining the weight of the contents subsequently. This he achieved by having two poises, one curled round the top of the beam, and one curled round the bottom of the beam, so that each could be moved independently past the other. This was obviously useful in heavy industry, loading goods into a railroad car while the car was already in position on the scales. Was this type of scales used at the bottom of the inclined plane, whereby the coal was lowered down the banks of the river in one of a pair of containers, and tipped out at the bottom? Being Joel Keeler, he slipped in a second idea yet again, this time for the poise holder that indicated the major weight of the load. By having the proportional poises held on flanges fixed to the holder, the user could identify the poises that were balancing the scale itself (at the bottom), the poises that balanced the container (sitting on the first flange) and the poises that balanced the load (sitting on the second flange.)

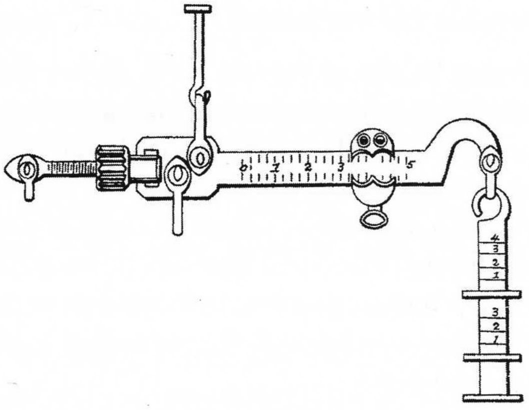
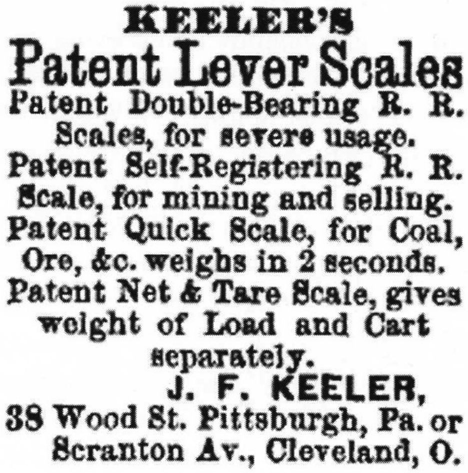


Fig. 4. Patent no. 57,921 of Sep 11, 1866. A full caption is on EQM 2688.



KEELER'S

Patent Lever Scales

Patent Double-Bearing R. R. Scales, for severe usage.

Patent Self-Registering R. R. Scale, for mining and selling.

Patent Quick Scale, for Coal, Ore, &c. weighs in 2 seconds.

Patent Net & Tare Scale, gives weight of Load and Cart separately.

J. F. KEELER,

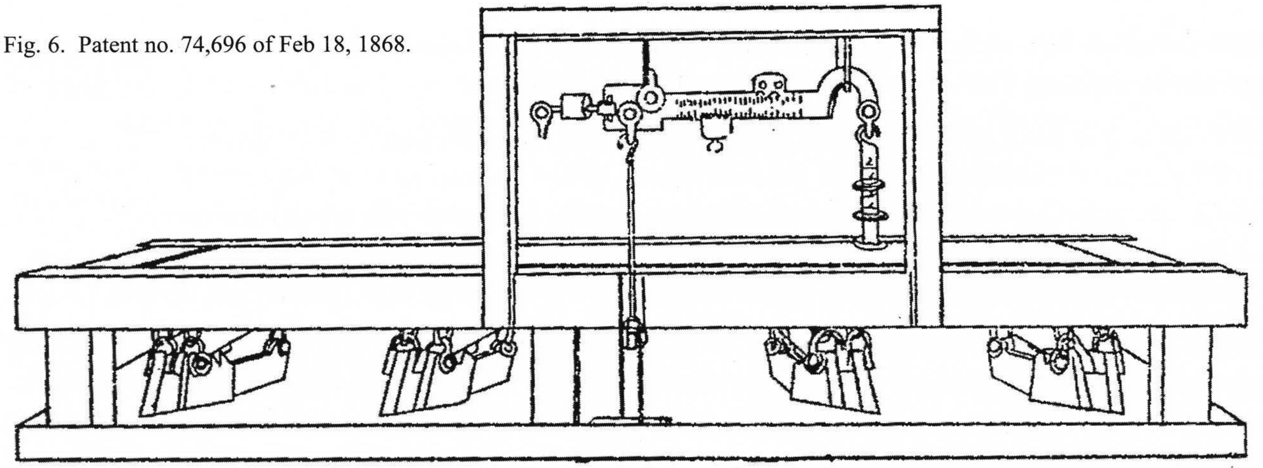
38 Wood St. Pittsburgh, Pa. or

Scranton Av., Cleveland, O.

Fig. 5. A newspaper advertisement of 1867, referring to Patent no. 57,921.

In 1867 he was listed selling *patent lever scales*, but no business address was listed, and he was living in a hotel in downtown Pittsburgh. There is an 1867 advert regarding Keeler's patent. In that, his address was Wood Street, Pittsburgh (downtown) and also Scranton Avenue, Cleveland, Ohio. This is interesting, because he gave an address in Cleveland that was different from the address in the *Cleveland City Directory* in 1867-8. The *City Directory* recorded his factory at Seneca, South Bridge, and his

Fig. 6. Patent no. 74,696 of Feb 18, 1868.



boarding house still as Bennet's House, Cleveland. By 1869-70, Joel's factory was recorded at number 255 on Seneca.

Patent 74,696 of Feb 18, 1868, shows that he was building extremely large platform scales, with a chain of levers long enough to weigh long railroad cars, with four or more units in the chain. *The scale to be made of great length, yet compact, and with as little depth of pit as possible, while at the same time the several parts are far enough apart to avoid hitting against each other in use, or freezing together in winter in exposed situations.* The scale was to be made of durable timber and the levers of wrought iron. He refered to the levers being connected by ice twice, so this must have been a serious problem in Pittsburgh winters. The object of the patent was designing the levers so that they overlap with the secondary levers alternately above and below each other, and thus took up little depth.

By May 19, 1868, patent number 78,098, he was after another class of customer, the smelters. *A machine for Weighing the Stock to be put into Furnaces for Smelting Ores and for other purposes.* He patents a *poly-poise* scale beam, that is, a beam divided into several arms to permit each ingredient to be weighed and added separately, and the beams connected to a registering device so that the manager could keep a check on the workmen operating the scale. He was getting wise to the need to phrase the patent in very general "catch-all" terms, so that nobody could evade his patent rights. This resulted in a horrible rush of "*any known shape*", "*any other known device*", "*appendages of weighing scales*" and "*something else than the scale*", that is less than helpful in understanding exactly what he himself was making. We rely on the drawings to inform us.

Patent number 78,748 of June 9, 1868, was a development, Keeler says, of his 1864 patent (for T-

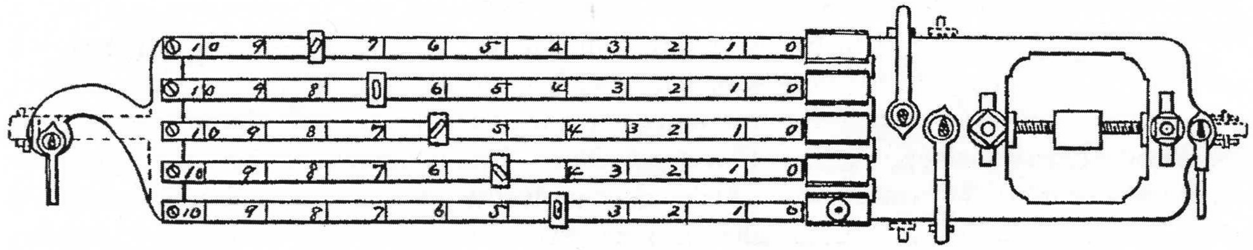


Fig. 7. ⮝⮝ Patent no. 78,098 of May 19, 1868

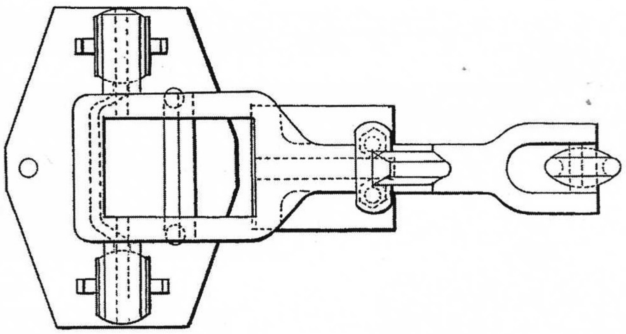


Fig. 8. AA Patent number 78,748 of Jun 9, 1868

form levers). It is difficult to see how this can be as Keeler was patenting a modification of hollow-headed levers to take two short knives, one each side of the hollow head, rather than one long knife. He commented that *hollow-headed scale-beams are usually made for weighing large weights, and the pivots or bearings are apt to work loose, if not bend or break, unless held by more than one end of the pivot*. He continued, writing that his old method of manufacturing was *not only difficult to make, and liable to inaccurate adjustment, by reason of the warping or springing of the metal in process of hardening, but also necessitates the weakening of the beam by making through the head so large a hole as is necessary for passing through it so large a piece of metal.* What a confession!! And again he referred to the detrimental effects of snow and ice.

Joel was listed as a scale maker in 1869, and in 1870 and 1871 as a scale manufacturer on Wood St, Pittsburgh. The 1871-1872 Cleveland city directory showed the following:

KEELER JOEL F, Manufacturer of Keeler's Patent Lever Scales; Office and Works 59 Scranton Av., res Pittsburgh. Railroad, Coal, Hay, Miners' and Wagon Scales a specialty. Peter Gerum, Supt.

Note that a superintendent ran the factory in Cleveland, obviously a necessity when Keeler was living in Pittsburgh. In 1872 his address was Smithfield Street (also downtown Pittsburgh) and in the same office was an H J Keeler, Agent. We have not identified the relationship between Joel and Hiram J Keeler yet, but working in the same office, we can assume some connection.

In 1872-3, Joel still had his factory at 59 Scranton Avenue in Cleveland. Given that Wood Street, Pittsburgh was an office, rather than a factory, we must seriously consider the possibility that Joel made all his scales in Cleveland and shipped them to Pittsburgh.

The next patent Joel took out was number 139,897 of Jun 17, 1873. He excelled himself this time, patenting five different features! The drawings show a huge steelyard beam beside a long house that covers all the connected platform levers, the length of a railroad car. Joel wished to (a) reduce the depth of the pit, or substantially obviate it altogether; (b) take the platform levers of the scale out of the dampness of the pit and secure them against rust, and also placing them in an accessible position for adjustment and repairs by placing them in boxes on each side of the platform; (c) preventing the pit from being filled with snow and other material through the crevices around the platform by roofing it over, and thus fitting it for use at coal mines and in snowy countries; (d) rendering the scale more perfectly self-indicating than it has before been made; and (e) preventing displacement of the weighing-levers, and wearing

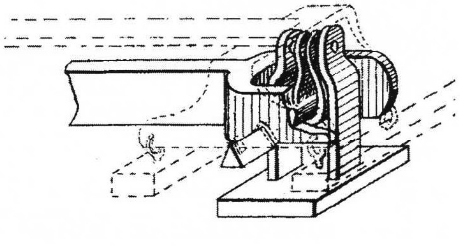


Fig. 9. AA Detail of Patent no. 139,897 of Jun 17, 1873

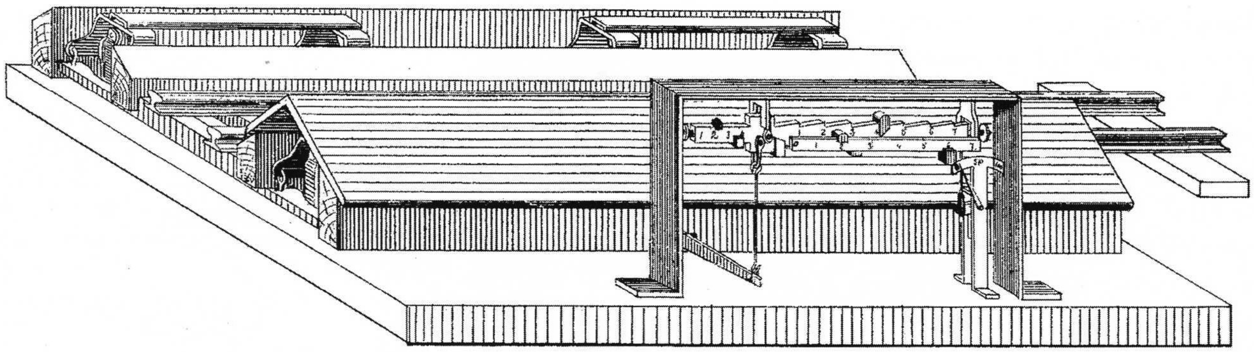


Fig. 10. AA Patent no. 139,897 of Jun 17, 1873, showing the covers over the pits to keep out the water that froze so inconveniently!

of the bearings and breakage of the scale from running fast trains of cars and other vehicles over it. So Joel's interests were, in this patent, all brought together in one grand bundle. The only fresh interest was in adjustment and repairs.

The last patent was number 152,752, of July 7, 1874, the application being filed in June 1871, and signed by Joel Keeler, but the patent was not issued until 1874, by which time Hiram J Keeler was the administrator. It was for a platform scale particularly suitable for weighing stock [ingredients] going into an iron-ore furnace. Each ingredient was weighed individually, and the operator could only progress to weighing the next ingredient after the counterpoise for the previous ingredient had slipped off the beam (which could only occur when the precise load balanced the beam), so the operator could not be sloppy in his work. He flicked levers to put the next counterpoise onto the beam, and again had to put the right amount into the cart to bring the beam to balance, thus allowing the counterpoise to be slipped off the beam .... The operator was watched by the furnace-filler up on the walkway of the furnace, and the filler had to record the ingredients independently by pulling the long arms that went down from his walkway to the platform scale, this independent check being needed to prevent fraud and accidental error. The cart had to be taken up onto the walkway to be tipped into the top of the furnace, and the

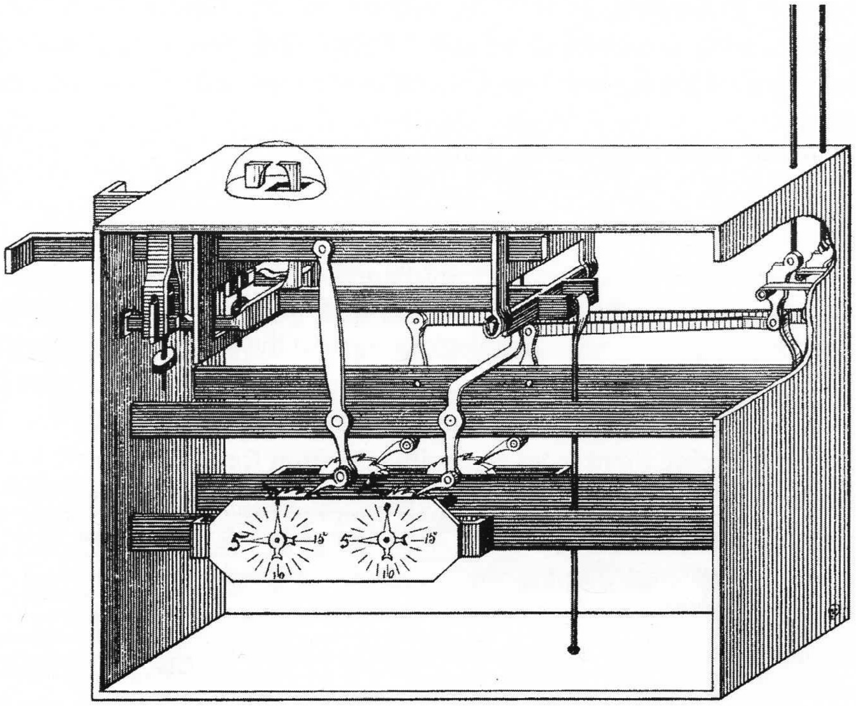


Fig. 11. AA Detail of Patent no. 152,752, of July 7, 1874

long lever pulled to record within the scale the time at which the furnace was loaded.

What image do we get of this man, Joel H Keeler? He was not prepared to tolerate the inadequacies of his scales. He worked for 19 years, patenting improvements. He hated water, rust and freezing conditions, fraud and errors.

Joel died between 1872 and 1874, as an inventory of his estate was made in 1874. He made no will, and it apparently took a while to settle the estate, as there was a final 1878 document doing so. The executor of the estate was Hiram J Keeler, a lawyer born in 1818, the year before Joel. By 1874, Joel's business on Smithfield St had been taken over by Hiram, but Hiram resided in Terre Haute, Indiana, 300 miles west of Pittsburgh. In 1875 and 1876 there was no listing in the trade directories. From 1878 to 1880 H J Keeler Scale Co was on 1st Avenue, Pittsburgh and Hiram was living in Brownsville, PA (outside of Pittsburgh).

Compared with Fairbanks, any Pittsburgh company is going to look small, but Pittsburgh companies had the advantage of all the necessary materials to build big scales, and being able to supply them much more cheaply than Fairbanks would have been able to, using local labour. Joel Keeler gradually built up his business, supplying scales crucial to Cleveland and Pittsburgh industry, tailoring his manufacture to suit heavy industry, the coal mines, the smelters, the blast furnaces, the movement of heavy loads in bulk, the railroads connecting eastern America with western America.

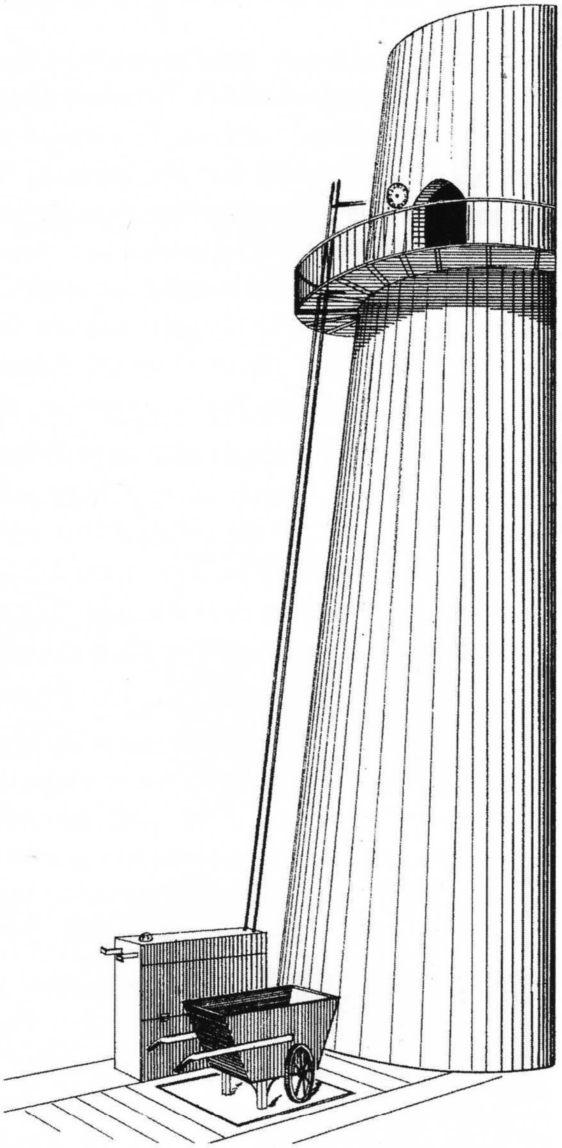


Fig. 12. ▲▲ Patent no. 152,752, of July 7, 1874

Authors' Biographies

Joel and Hiram Keeler have been researched in Pittsburgh by Carol Paterson. Carol is a professional historian and author, and a friend of Mary Anne Murphy's. Duncan Gardiner did the research in Cleveland. He, apart from collecting scales and being a member of ISASC, is also a highly professional researcher, Certified Genealogist, and Accredited Genealogist specializing in Czech, Slovak, and German Ancestries. ISASC has benefited from Duncan's expertise. Mary Anne Murphy has co-ordinated the research, and given her whole-hearted help throughout.

Notes & References

Cleveland Newspapers
Daily True Democrat
Forest City Democrat
Leader

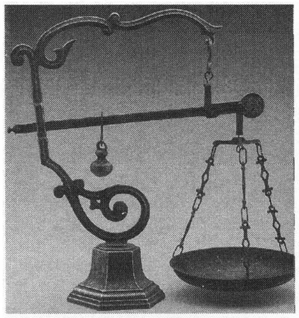
Cleveland City Directories from 1840-1880.
Ohio Census Records

Fakes & Reproductions

Recently an auction in the Cotswolds, UK, included reproduction wool weights with their moulds. These weights were superbly copied with an excellent patina. Prices were those normally given for genuine weights. It is believed that Mr. Nicholls of Upper Slaughter made the weights for his own pleasure, buying originals, copying them and selling the originals. The auctioneer was apparently unaware of this, and did not identify the weights as copies. In the same auction was a little steelyard that Mr. Nicholls had not finished. The obvious way to identify it as a copy (apart from the flashings still being there) was to look at the graduations that were cast in, not chiselled after casting.

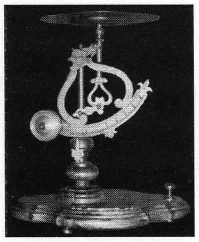
A company called Italned Ltd is importing reproductions from Italy, not intended as fakes, merely selling them as cheap lively metal objects to decorate the home. Their range is immense. If the original was under 18ins (450mm) tall, made of brass or silver-plated, and looks attractive to modern eyes, this company makes copies! Some of the measures look a little strange to British eyes because they are copies of European items, but we need to be aware that they copy British-style scales and weights.

A check should be made on nesting weights. If the outer one weighs the same as all the ones inside it, the weights are probably genuine. If a cup is missing, this check is impossible, but some are so badly made that even an approximate check shows that they are not adjusted. If the weights rattle inside the house, be suspicious. A very handsome nesting set came on the market about three years ago, made of a pewtery metal. They were beautifully-made, tight-fitting and well-finished, but they did not weigh accurately, so the only conclusion had to be that they were fakes.



Weight collectors are suffering from a large selection of number weights made recently. The shape of the weights is accurate although the corners are not as rubbed as properly used ones, and the patina is patchy and unrealistic. The inspectors' stamps are flat-bottomed, being milled out, not stamped with V-shaped tools. A good magnifying lens is necessary to see the difference from genuine stamps, and it helps to be familiar with real stamps of the early 20th century. The maker of these weights was extremely fortunate not to be prosecuted for imitating W & M stamps.

Large decorative scales by Libra of Portugal appear on the market regularly. They are copies of genuine Portuguese scales, often with bull's head finials, the larger versions have a little scale hanging from the pillar of the big scale, and they have a block with concave sides for the weights. As genuine versions survive, care needs to be taken to identify the copies. Pull out a knobbed weight and examine the filling inside the block. If it is gleaming white plaster, the chances are it is a copy. Check for verification marks, as genuine ones were examined by the W & M inspector. Crawforth considered Libra to be the best copiest, and was grateful that the company stamped their name on their products.



Beginners' Guide Part 5

These variations on steelyards were never much used, being inaccurate and rather unstable. They were used as postal scales, coin scales, and various special-purpose scales in the home or in the rear of factories. Inspectors in most countries would not permit their use for trade.

5. Unequal arms

Beam	Straight. Unequal arms. MAIN FEATURE.
Resistant	Fixed poise
Resistant	For one unit only.
Fulcrum	Off-centre.
Load	Fixed pivot
Stabilised by	Suspended from hook or fingers. Load below beam.
Graduations for equal units	No graduations MAIN FEATURE
Common names	No names, as not for trade.

Unequal arm scales

Unequal arm scales had no moving pivots, and were intended to indicate one weight only, the ratio being built into the beam when it was made. One example, used on a hook in a barn, to weigh 7lb bales of wool, had the load end eight inches away from the fulcrum and the beam 32ins long, which theoretically would not balance 7lb, were it not for the chains of the same length hanging from each end, one with a hook to take the load, and the other with a wooden handle to swing the bale from one position to another. Because the handle's chain was four times as far from the fulcrum, the instrument indicated 7lb. Crude but adequate.

Unequal arm scales with weights

These contracting beams were an early way of utilizing the lever principle to weigh heavy loads. Put a light poise at the end of the long arm, and it balanced a heavy load at the other end. The poises had to have the same ratio as the beam. If the load weighed 1lb, and the end of the arm was ten times as far from the fulcrum as the load, then a poise of only $^{1}/_{10}$lb was needed. The advantage over a steelyard was that the poise did not have to be moved along the beam, but the disadvantage was that several poises were needed to make up one ton.

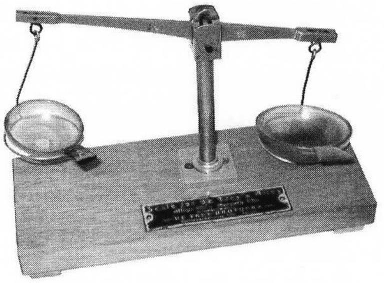


Fig. 1. ▲▲ It is difficult to think of a better application of the unequal arm principle. The dentist had merely to fill one pan, then pour into the other pan until the beam balanced. "Scale for de Trey's Alloy. Alloy: 10 Mercury: 13,5. DE TREY BROTHERS. Mühlebachstrasse 126, Zurich". The smaller pan and the longer arm are both marked A [Alloy], and the shorter arm is marked Hg [the chemical symbol for mercury]. The scale is shown in Gottlieb Kern's catalogue of 1933.

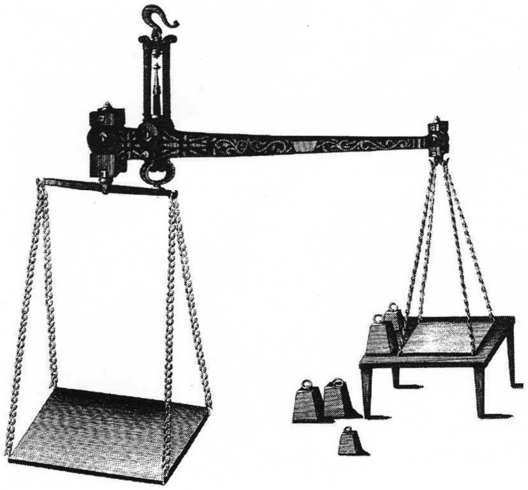


Fig. 2. ◀◀ Unequal arm scales with weights. This Contracting beam relied on proportional weights to indicate the load, so was particularly useful in weighing heavy loads up to one ton before the use of platform scales for trade use (as opposed to non-trade weighing of wagons or people.) In Thomas Beach catalogue, so made before 1797. A 1lb weight indicated a 7lb load.

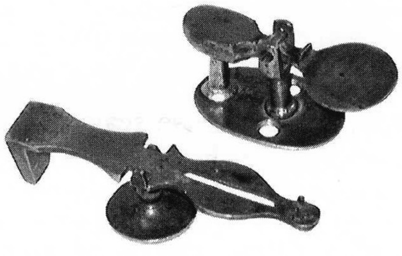


Fig. 3. ▲▲ No moving pivots. Front rocker English, for the sovereign only. 3ins long. Brass. Made after 1816.
Rear rocker of unknown origin, for unknown coin. 2ins long. Brass.

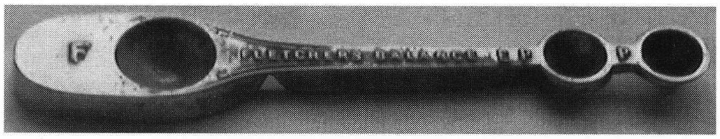


Fig. 4. ▲▲ This unequal beam is of unknown origin. Looking at it, it is probably a balance for mixing dental alloy of two alternative ratios. If the big pan F is filled, the inner pan labelled EP could be filled to balance the load in the F pan, or alternatively the outer pan labelled P could be filled. Fletcher's Balance made of nickel-plated brass. The fulcrum is provided by the user putting a knife in the groove. Cheap, simple and effective.

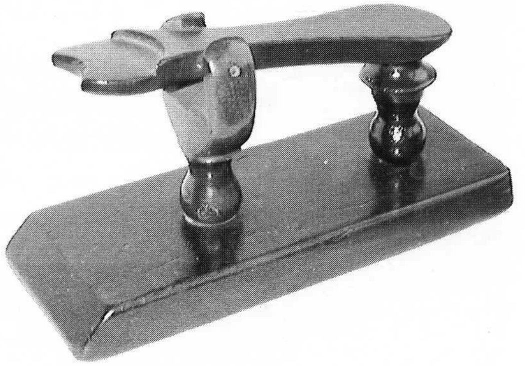


Fig. 5. ➢➢ This rocker uses the unequal arm to balance only one coin, the full-weight guinea of 5dwt 9 grains. It has, carved into the dark fruit wood, underneath, 1747. It has a tiny 'pip' of lead inserted in the centre of the coin platter.

6. Bismars

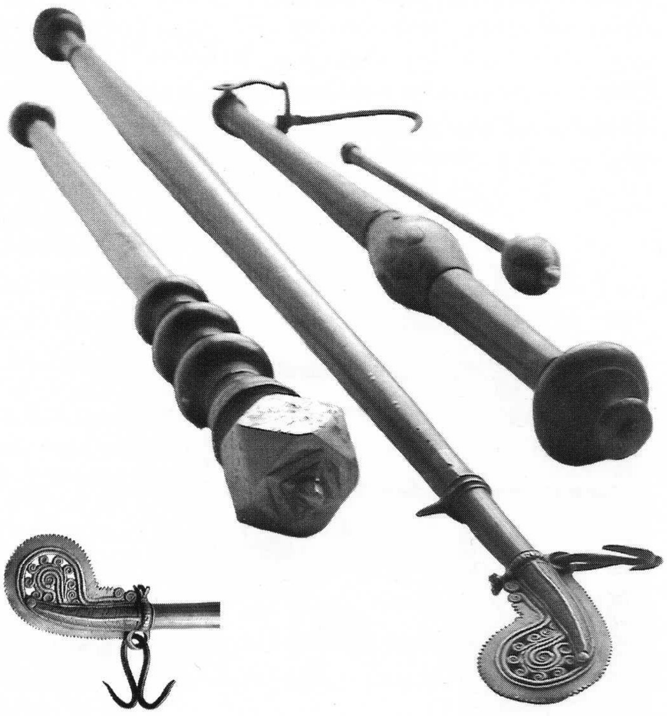
Beam	Straight. Unequal arms
Resistant	Fixed poise
Fulcrum	Moving along the beam. MAIN FEATURE
Load	Fixed pivot
Stabilised by	Either suspended or on a pillar
Graduations for equal units	Units closer together as load increases. MAIN FEATURE Units largest nearest the fulcrum.
Common names	Occasionally called auncel, pundlar, pounder, scheft

Fig. 6. ➢➢ Trade bismars from, left to right, Russia, Indian, Russian and possibly Persian, all without their fulcrum thong. The Russian bismar is dated 1829 with the town and maker (in scrawled Cyrillic script) on the brass poise end, the dark wood is nicely turned, and the brass (sheathing the wooden beam) is lightly punched with dots to indicate graduations, of about 12lbs (5 kilos) in six units. It was extremely easy to cheat with such a bismar.

The Indian bismar appears to have three sets of graduations, on top and each side of the beam, but a second look shows that the main units are along the top, and the sub-divisions are clearly shown as double silver pins along the sides. Thus, if the fulcrum thong is between the double pins, the number of units can be confidently (if slowly) counted by the customer. The load hook has above it a pretty four-petalled flower. See inset fig. Both ends are capped with brass. The four main graduations cover the capacity of about 8lbs (3 kilos). The bismar is 40ins (1020mm) long, a most unwieldy length for carrying through crowds.

The second Russian bismar is a cheaper, more modern one than the first one, being made of pine wood crudely sheathed in a whitish brass at each end. The five graduations cover a capacity of about 13lbs (6 kilos).

The Persian (?) bismar is an elegant shape, all of steel, but crudely slashed to indicate the units. The 16 graduations cover the capacity of about 7lbs (3 kilos).



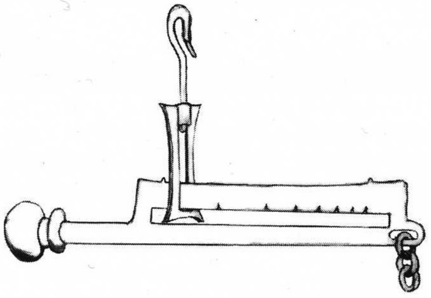
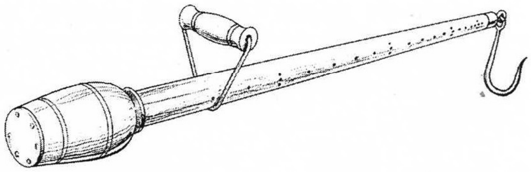


Fig. 7. ⮝⮝ This Roman period bismar has the useful design of a slot in the beam that prevents the shears from getting lost. Most bismars had the fulcrum made from a wooden handle and a leather thong that moved over the beam, with no means of fastening it to the bismar, so most fulcrums got lost.

Fig. 8. ➤➤ Bismar from the Orkney Islands, part of the Danish culture. The thong has a wooden handle to make it easier to lift.



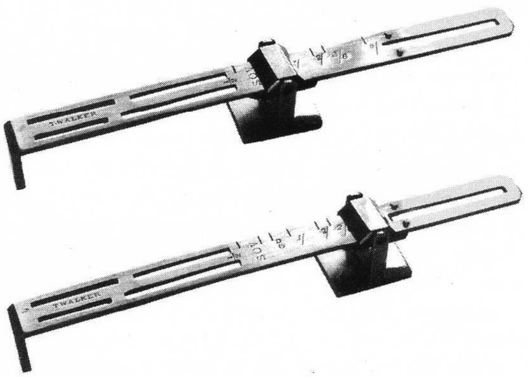
At first glance, the bismar is the perfect scale. It needs only a straight stick and a thong to hang it by. No weights, no case, nothing to go wrong. The load was hooked onto one end, and the thong moved along the beam until the bismar balanced, the graduations indicated the weight, and all was done.

But look at the reality. The thong was difficult to move along once the load was suspended, and the beam had a horrible tendency to tip and skid even when it was balanced. The thong was easily lost, as most thongs were separate from the bismar. The thong had to be held in position long enough for the graduations to be read (and most bismars had no numbers against the graduations, so the slashes or lines had to be counted from the beginning, a beginning that might well not be zero!) The customer could not easily see what the trader was reading, and had to trust that he was measuring out the amount specified. But possibly the worst aspect was that the graduations got closer together as the load increased, so the bismar was at its most accurate for the smallest load, and extremely inaccurate for larger loads, especially as it was very difficult to see exactly where the thong was placed.

Some civilizations tolerated the use of the bismar in trade, but most did not. Without going into fine detail, the main areas they were used for trade were in the Roman culture, in Britain before 1428, the Burmese peninsula until the late 19th century, and the Danish culture until the 20th century. Judging from the four shown in Fig 6, they had a capacity of about 7 -12lbs, and were probably at their most useful weighing loads of about half that amount. A customer (buying for a family with about four children) would need potatoes, corn or cabbages weighing about that amount.

Fig. 9. ➤➤ The bismar is suitable for coin checking because the instrument is compact, there is no poise to lose, and the flat beam is big enough to show the graduations very clearly. The pillars have a rigid block across the top holding the knife-edges supporting the beam. The block moves along the beam, as shown in the two views. This English bismar was made by T Walker after 1849, the year that the 2/- [Florin] was first minted. The coins checked were the Sovereign, ½ sovereign, 6d, 1/-, 2/-, 2/6 and 5/- The morocco-covered case contains a label saying "TO TEST A SUSPECTED SILVER COIN, try it in its appropriate gauge, then move the edge of the slide to the mark before the figures indicating that Coin and place the Coin between the two pins and the end of the beam; a genuine Coin, if new, will draw [drop] when close to the pins if old at a short distance from the pins, a counterfeit will not draw unless placed at the end of the beam. For Gold Coins, the opposite edge of the slide is placed at the mark, after the mark Sov. and half Sov."

Courtesy G Chellingworth



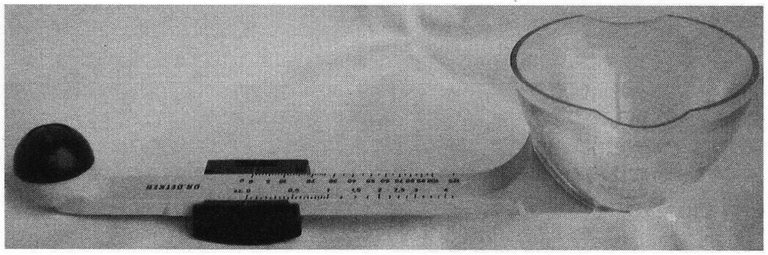
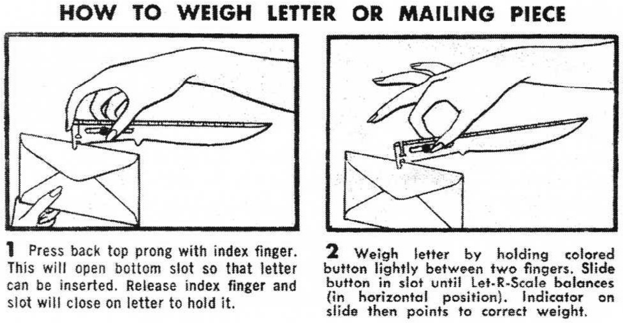


Fig. 10. ⮜⮜ This bismar shows the greatest precision under the first ounce, which takes up over a third of the length of graduations that go up to 4oz. The fulcrum is a curved block, giving continuous, smooth movement from one position to the next. The spirit level set into the block indicates when it is truly level. This spirit level gives this cooking scoop a surprising degree of accuracy throughout its capacity. Having such smooth surfaces, and only one moving part, it is easy to clean. Made in Germany for the health-food manufacturer Dr. Oetker, c.1980.


HOW TO WEIGH LETTER OR MAILING PIECE

1 Press back top prong with index finger. This will open bottom slot so that letter can be inserted. Release index finger and slot will close on letter to hold it.

2 Weigh letter by holding colored button lightly between two fingers. Slide button in slot until Let-R-Scale balances (in horizontal position). Indicator on slide then points to correct weight.

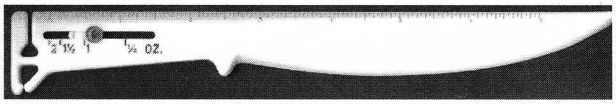


Fig. 11. ⮝⮝ The fulcrum is a swivelling button on a tiny plastic block that slides along a slot in the beam. The cream-coloured plastic and red button are reminiscent of the Linex range of swivel-buttoned bismars made in Denmark, but the instruction leaflet (shown on the left) gives no maker's name The back surface of the bismar advertises "Canadian Club, The Best In The House".

Attempts were made in 1352 by the King of England to ban the use of the bismar because numerous merchants complained about the fraud it engendered. This proclamation was ignored, but the combined might of the Chichelye brothers, two of whom had been Master of Grocers' Company (the Company that checked scales and weights in the City of London), the third being a Member of Parliament, and the fourth being the Archbishop of Canterbury, who, using the threat of excommunication, more-or-less eliminated its use in England in 1428.

There was a second flowering of bismars in Britain in the 19th century, for home use, when numerous letter and coin scales were invented. The principles did not vary, the fulcrum always slid along the beam, but sometimes the beam rested on pillars, and sometimes the beam hung from shears. The graduations were indicated by the position of the fulcrum, which, by moving, increased the length of the arm one side while simultaneously decreasing the length of the arm on the other side, so the graduations got closer together as load increased. Thus, the bismar was more accurate when used to weigh the smaller loads in its range, and became increasingly approximate for weighing the heavier loads for which it appeared to be suitable.

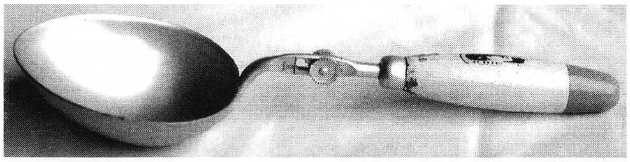


Fig. 12. ⮜⮜ Another example of the use of the bismar when good accuracy is not a requirement. This cooking scoop was patented in UK by W H Wallis in 1945, and made by Hartley of wood and aluminium. The swivelling button could be moved to either end of a slot in the beam, to weigh 1oz or ½oz only. In use, it is easy to flick the load out of the scoop unless handled very carefully. The wooden handle is difficult to clean because the paint flakes off when the scoop is placed in washing water.

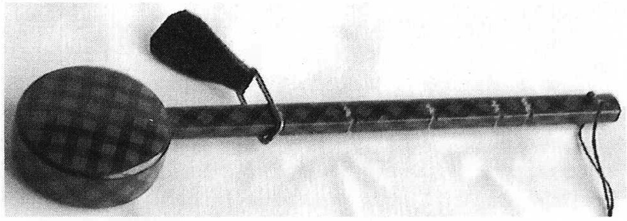


Fig. 13. ⮞⮞ When made, this beech-wood bismar was incredibly cheap to produce, but, because it is so rare and pretty, has become a very expensive collectible! The wood is lacquered [called Mauchline ware] with a red and black tartan, one of several tartans used by A Smith in Scotland to decorate his bismars. The graduations are gilt, ½P, 1P, 2P and 6P, [postages, or ½oz units for determining the rates of postage between 1840 and 1871 in UK]. On the back, in gilt lettering, it says "POSTAGE to India, and Australia, if prepaid - via Southampton, half oz...6d. Do, via Marseilles, qu. oz. 9d. - France, ¼oz. 4d. - U.S. half oz. 1s. - Canada 6d - A. SMITH, MAUCHLINE, AYRSHIRE PATENT POSTAGE BALANCE." [A Smith postal patent 14. 5. 1862.] The letter was placed into the loop of black cord, and a bead slipped down the loop until the letter was trapped. Note that the cost of sending a letter to Canada was only half what it cost to send a letter to USA, even though the distance was the same. This reflected the preference given to colonies of Great Britain during the Victorian period.

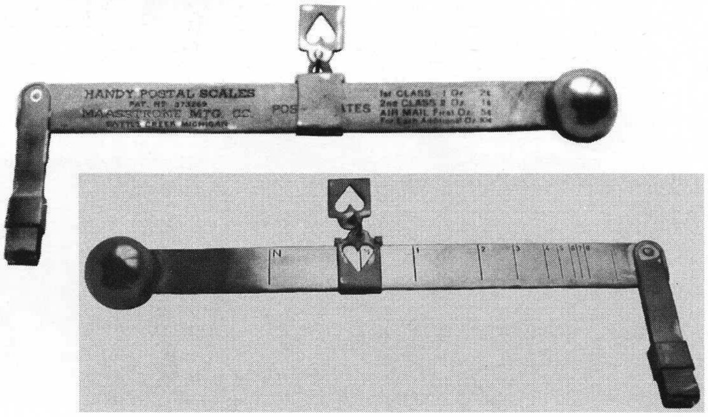
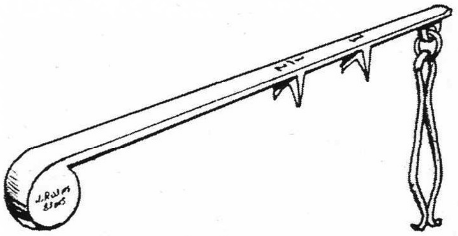


Fig. 14. ⮞⮞ Note the large space is for the first ½oz, compared with the tiny space for 7-8oz. The Maasstrone Mfg Co of Battle Creek, MN, stamped pat, no. 373269, on the beam, but that patent is completely irrelevant, being issued in 1888. for a music turner. Mistake? Fraud?

Fig.15. ➢➢ The famous US Martini Scale that utilises the bismar principle perfectly. "INSTRUCTIONS: 1. Set scale to desired Martini proportion. 2. Fill large jigger with GIN. 3. NOW pour DRY VERMOUTH into small jigger until scale balances. 25:1. 10:1. 5:1." Made of anodised aluminium coloured gold, and black stove-enamelled beam and pillars, on wood base.



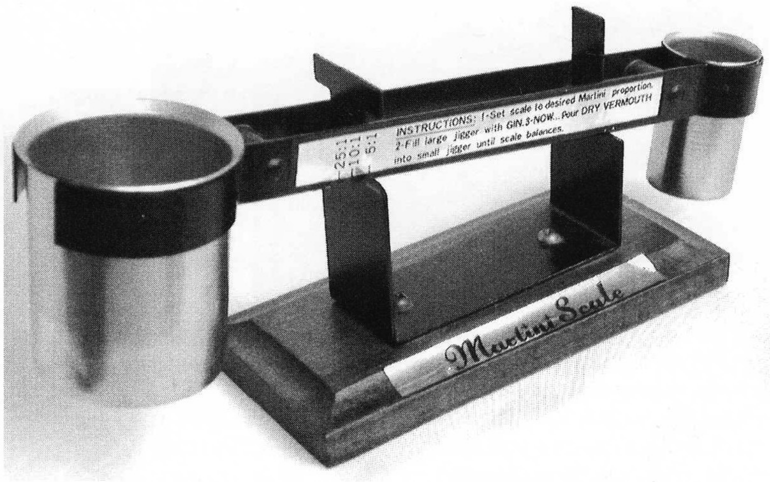

INSTRUCTIONS: 1-Set scale to desired Martini proportion.
2-Fill large jigger with GIN. 3-NOW...Pour DRY VERMOUTH
into small jigger until scale balances.
25:1
10:1
5:1
Martini Scale

Fig. 16. ⮝⮝ The fulcrum does not physically move. The user moves the bismar towards the edge of the shelf, or away from the edge, so that the bismar tips on the left-hand feet if the letter weighs over 1/2oz, and it tips on the right-hand feet if the letter weighs over an ounce. Made by J Rodgers & Sons c.1890. Made of nickel alloy [German silver].
Other examples of shelf-edge bismars are shown on the front cover EQM 2701.

7. Moving load scales

Beam	Straight. Unequal arms
Resistant	Fixed pivot
Fulcrum	Fixed pivot
Load	Moving along the beam. MAIN FEATURE
Stabilised by	Load hanging below the beam.
Graduations for equal units	Highest unit nearest the fulcrum MAIN FEATURE Units wider apart as load increases.

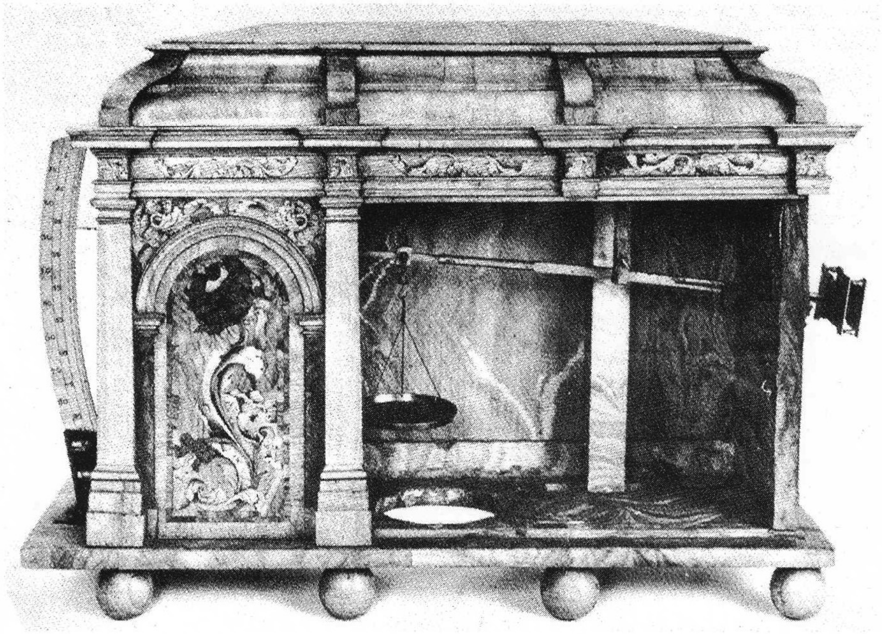
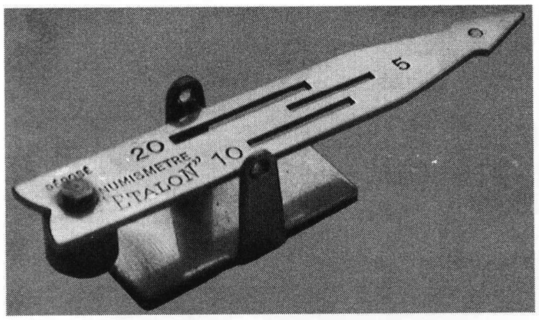


Fig. 17. ⮜⮜ The earliest known moving load scale, recorded by Jacob Leupold in his book *Theatrum Staticum Universale*, published in 1726. There is only one moving pivot, that of the load pan.

It was made by J A Cass of Kassel in about 1720, for hydrostatic weighing. The pointer swings in a slot in the case, against a graduated arc indicating specific gravity. The magnificent case shows that it was made for a rich man who owned a Cabinet of Scientific Instruments, a common hobby of rich men in the 18th century.

This balance is today exhibited in the Hessiches Landesmuseum in Kassel.

Courtesy of Astrom.-Physikal Kabinett, Kassel.



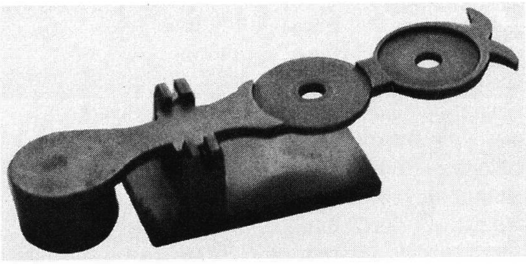


Fig. 19. ➤➤ Late 19th century German CCD without a gauge to check the thickness of the 20 and 10 Mark. Brass, with a removable beam.

Fig. 18. ▲▲ The problem of sloppy location was cured by having precise positioning of the load, in this case, by putting the coin vertically in the slot. Thus full weight was indicated and the thickness of the coin was checked. French ETALON NUMISMETRE for the 20, 10 and 5 Francs. Chromed brass.

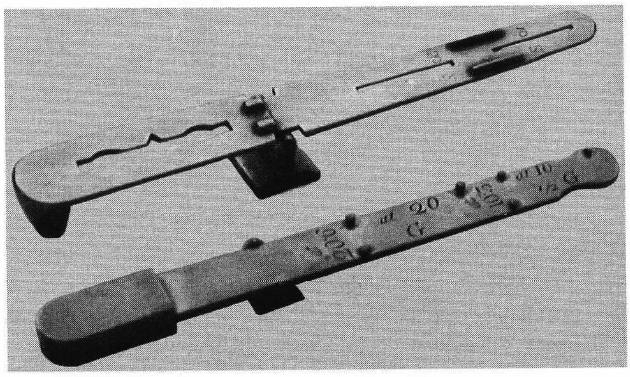
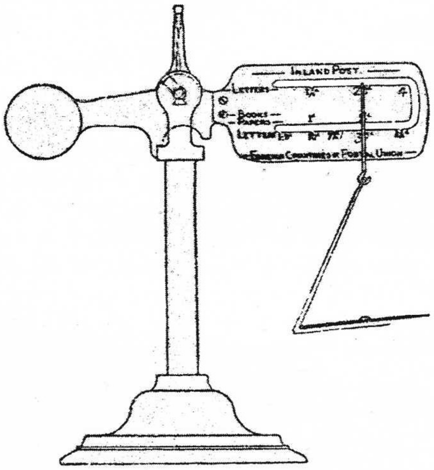


Fig. 20. ➤➤ Rear, English CCD for the sovereign and half-sovereign, made after 1816. Front, English CCD by W Lane between 1774 and 1776, for light guineas of 20/6 and 20s, and light half-guineas of 10/3 and 10s.

Moving load scales have a fixed poise (often just an undifferentiated part of the beam) and a fixed fulcrum. The load is either fixed in a hanging position under a hook or clip, or it is above the beam, in a slot or platter. The important feature is that the graduations are most accurate for the smallest loads, and become increasingly inaccurate for greater loads as the load moves nearer the fulcrum. Nearly all have a capacity of 4oz or less. Nearly all are merely indicators of "Over or Under" weight.


INLAND POST.
LETTERS
BOOKS PAPERS
FOREIGN COUNTRIES OF POSTAL UNION

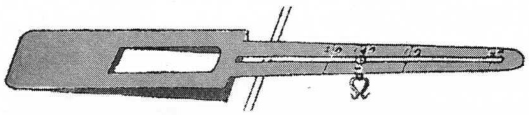


Fig. 21. ◀◀ Another shelf-edge moving load scale for weighing letters. Patented in UK by T Saltingstall-Taylor on 18. 1. 1900.

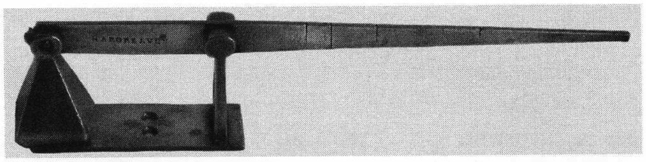


Fig. 23. ▲▲ Moving load scale for weighing letters. Units 4oz, 3oz, 2oz and 1oz. The hanging clip is missing. It has holes in the base so that it can be screwed securely to a shelf. It is stamped HARGREAVES on the beam, possibly being William Hargreaves of Sheffield, working between 1870 and 1892.

Fig. 22. ▲▲ This moving load scale is for postal use. Because the load is suspended below a proper pivot, the exact weight could be indicated, but, in fact, it is another "over or under" scale. Frederick Henry Smith was from Baltimore, MD, USA. His British patent of 26.5.1888 is interesting and unusual.

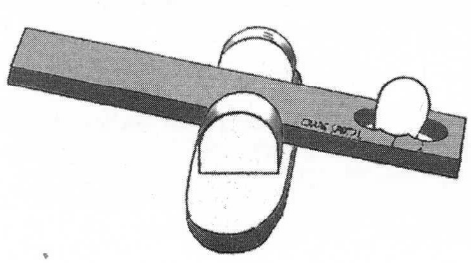
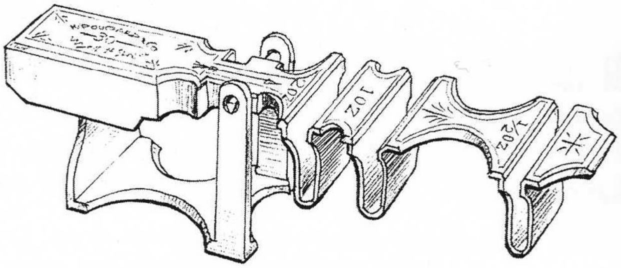


Fig. 24. ◀◀ One of several egg scales that depended on the user moving the egg into several positions before knowing the category of that egg, in this case, Special, first, second or third grade. Patented by A B G Horton of South View Poultry Farm, Nacton, near Ipswich, on March 15, 1930. Most egg scales seem to have been invented by people keeping chickens, so the results are often impractical, inaccurate and difficult to use, although this one only has the disadvantage of a lot of handling of each egg. This example was invented only two years after the first egg scale was patented in Britain.



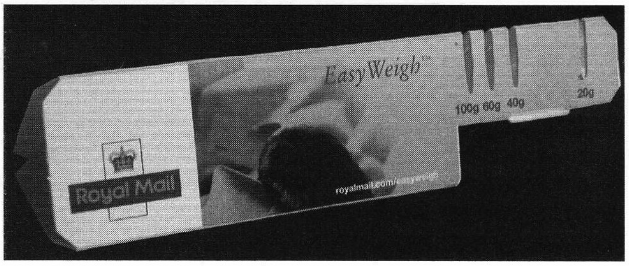


Fig. 25 and 26. ⮝⮝ Two moving load scales that demonstrate the same fault. Both have slots in which the user stands the letter. The wider the slot, the greater the error in indicating which postage rate is necessary. The higher the letter sticks up above the beam the more error will occur depending on whether the letter tips towards the fulcrum or away from it. A 40gram letter appeared to be under 40grams when it tipped towards the fulcrum, but more than 40grams when it tipped the other way when put onto the cardboard Easy Weigh, offered by the Royal Mail as a Free Offer in 2001. The heavy brass rocker that Wm. Poupard, made about 1850, has the same problem.

Moving load scales are not common, except for one type, the rocker CCD and the rocker egg scale, where the load is above the beam, accurately located by a ring, slot or circular platter. Some designers failed to appreciate the need for the load to be precisely located, and provided sloppy positions.

Cruciform rockers were used in two cultures, the mediaeval English culture, and the Greco-Turkish culture of the nineteenth century. These tiny pocket scales weighed between one and seven coins, depending on the number of overlapping platters. They all depended on the exact location of the coin, and unless the coin was absolutely circular, it could not be accurately located. So these cruciform rockers must have been of limited use in the mediaeval period when coins were only approximately circular.

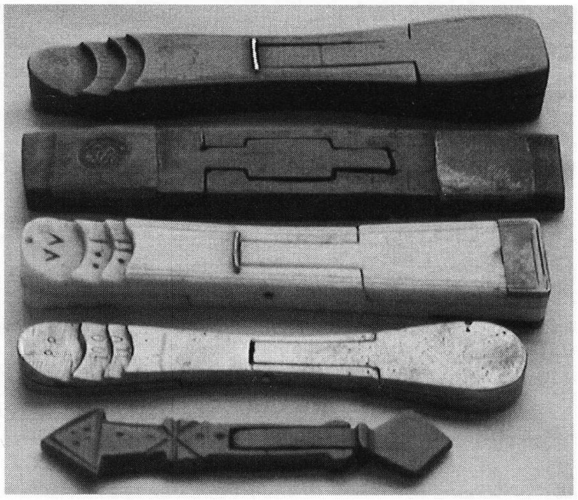


Fig. 27. ➢➢ Cruciform rockers. When opened out, one arm is held vertically between finger and thumb, while the horizontal arm takes the coin being checked.

From the rear, (1) Turko-Greek boxwood rocker, with the Caliph's mark, so pre-1900, but not much earlier than 1900 because the coin platters are labelled in Arabic numerals, 55, 51, and 44 on the arm that is underneath [and the coin 50 between the 55 and the 51 is not mentioned because its ledge is so small, no room is available to write the number], and on the top arm, the coin platters are labelled 110, 100 and 88. A particularly attractive piece of satiny finish of honey colour. See also Fig. 28.

(2) Turko-Greek slate rocker with the Caliph's mark, so pre-1900, for four coins only, but with nothing to indicate which coins could be checked. Both arms are weighted by the addition of a lead insert. A very rare item of unknown date.

(3) Turko-Greek bone rocker, not verified. The numerals are in Greek, for the same seven coins as (1) above, so presumed to be well before 1900. The bone is weighted with brass inserts on each arm. Another piece which is nice to caress.

(4) Turko-Greek brass rocker, not verified. For the same seven coins as item (1) above, with the labelling in Arabic numbers. C.1900.

(5) Probably English bronze rocker for the two silver pennies, c.1390. Because of the difficulty of correctly placing the coin, it is extremely difficult to be certain which coin was being tested.

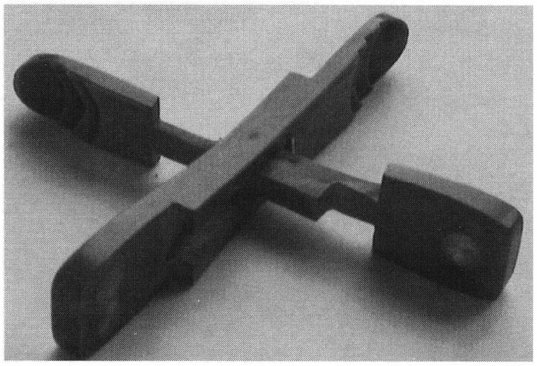
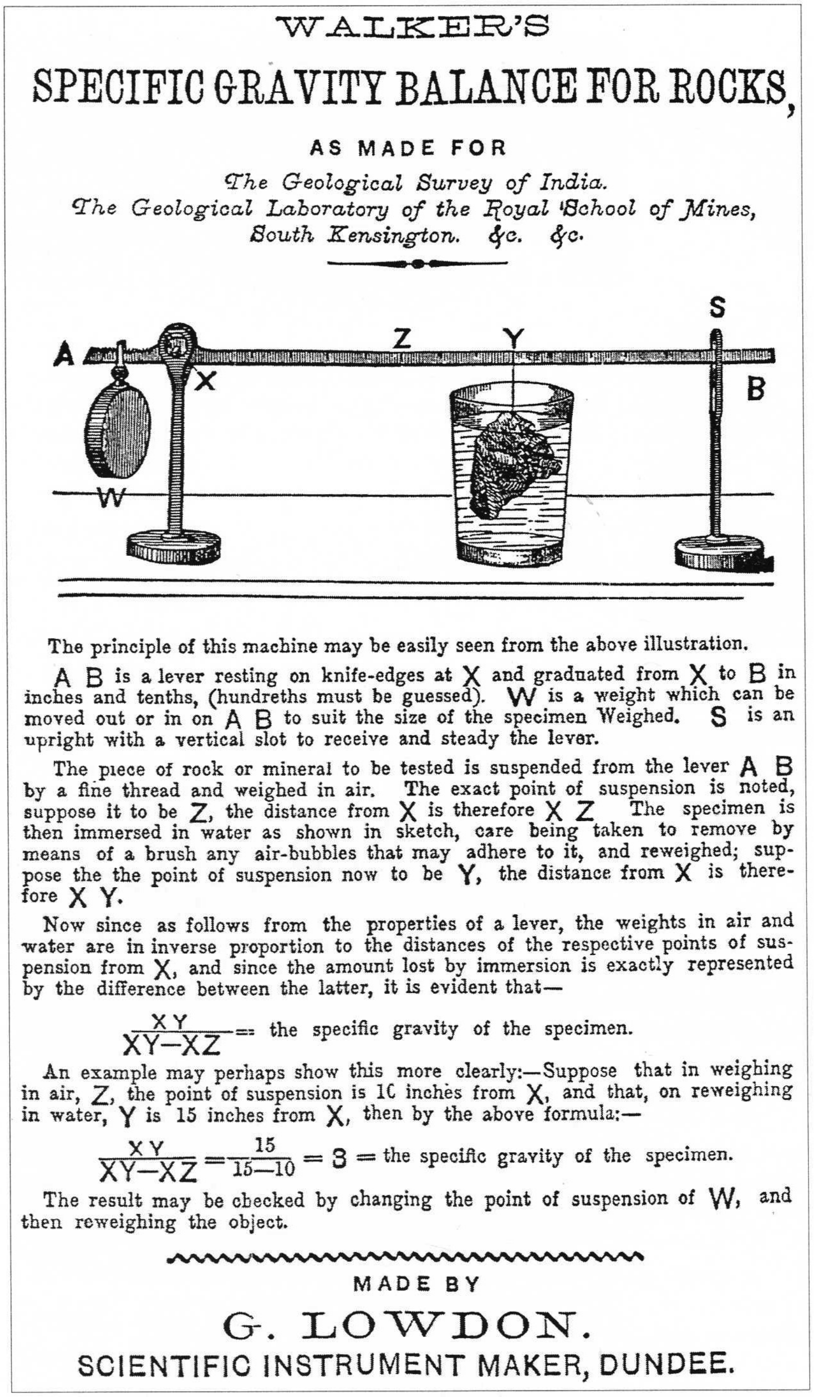


Fig. 28. ➢➢ A cruciform rocker opened out to show the stepped overlapping platters on which the coins are placed. Note the lead insert under the right-hand arm.



WALKER'S

SPECIFIC GRAVITY BALANCE FOR ROCKS,

AS MADE FOR

The Geological Survey of India.
The Geological Laboratory of the Royal School of Mines,
South Kensington. &c. &c.

The principle of this machine may be easily seen from the above illustration.

A B is a lever resting on knife-edges at X and graduated from X to B in inches and tenths, (hundreths must be guessed). W is a weight which can be moved out or in on A B to suit the size of the specimen Weighed. S is an upright with a vertical slot to receive and steady the lever.

The piece of rock or mineral to be tested is suspended from the lever A B by a fine thread and weighed in air. The exact point of suspension is noted, suppose it to be Z, the distance from X is therefore X Z. The specimen is then immersed in water as shown in sketch, care being taken to remove by means of a brush any air-bubbles that may adhere to it, and reweighed; suppose the the point of suspension now to be Y, the distance from X is therefore X Y.

Now since as follows from the properties of a lever, the weights in air and water are in inverse proportion to the distances of the respective points of suspension from X, and since the amount lost by immersion is exactly represented by the difference between the latter, it is evident that—

$$\frac{XY}{XY-XZ} = \text{the specific gravity of the specimen.}$$

An example may perhaps show this more clearly:—Suppose that in weighing in air, Z, the point of suspension is 10 inches from X, and that, on reweighing in water, Y is 15 inches from X, then by the above formula:—

$$\frac{XY}{XY-XZ} = \frac{15}{15-10} = 3 = \text{the specific gravity of the specimen.}$$

The result may be checked by changing the point of suspension of W, and then reweighing the object.

MADE BY

G. LOWDON.

SCIENTIFIC INSTRUMENT MAKER, DUNDEE.

Fig. 29. << Moving load scale for geologists. An explanation in plain English is provided in EQM 1033.

Fig. 30. ⋎⋎ Moving load scale patented in the UK by S W Suffield in Sep 26, 1888 for weighing letters, or for weighing grain. Suffield is not known to have made this, but he did manufacture his postal bismar, shown in EQM 568 and 1030.

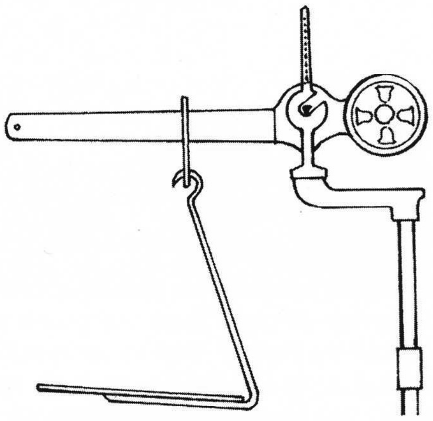


Fig. 31. ⋎⋎ This moving load scale combines the functions of postal and coin scale, and the inventor, Charles Richtmann, claims that it has a high degree of accuracy. Unfortunately the highest value load - the 20 Dollar piece, is weighed the least accurately, and the lowest value load - the 1 dollar piece - is weighed most accuratcly. The top set of graduations indicate silver dollars, the middle set indicates gold dollars and the bottom graduations indicate ounces. Patented by C Richtmann of New York, and assigned to H Richtmann & Co, of New York on March 25, 1884. [Newman & Mallis do not say in *US Coin Scales and Counterfeit Coin Detectors*, whether this design was ever manufactured.]

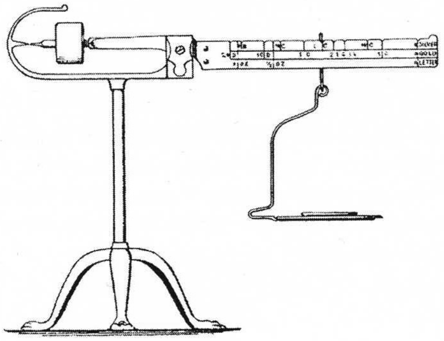
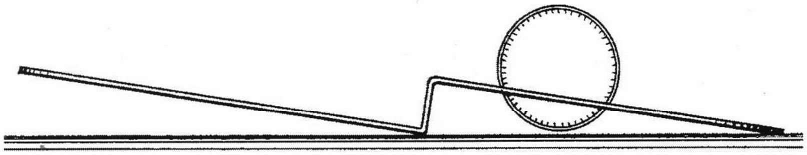


Fig. 32. ⋎⋎ The simplest moving load scale made - a bent sheet of metal, with up to 8 slots for coin positions, and 8 gauges. US patent of J A Thompson, Feb 27, 1877, made by Thompson & Berrian Mfg Co and sold by John Chatillon & Sons.



Review

Pondera - pesi e misure nell'antichità, (Pondera - weights and measures in Antiquity), Museo della Bilancia, Campogalliano, 2001, soft bound, 410 glossy A4 pages (weighing 1800g!), 62 drawings (many multiples), 36 charts & graphs, 8 maps, 208 photos, large bibliography, ISBN 88-86143-14-1, Ed. Libra 93. Price 31 Euros (about $33 or £20.00).

The volume contains papers published for the exhibition held in the Museo della Bilancia. This review is limited to those papers on weighing, omitting those on measures and economic interest.

The Bronze Age is covered by four papers of archaeological interest: *Weight systems in the circulation of metals in the European Bronze Age* by Peroni, *Findings of weighing elements in the culture of the steppes* by Bosi, *Weights and scales in the Italian Bronze Age* by Cardarelli, Pacciarelli, Pallante and Bellintani and *The Madriolo Repository* by Borgna. They deal with the difficulty of differentiating weights from other archaeological finds, like metal scraps. One of the main problems is to identify the relevant standard unit, as many standards existed, since weights were made in Greece by the second millennium BC and weights of oriental standard were used in Europe by the third millennium BC. Particularly interesting middle Bronze Age lenticular weights were formed with a groove that was used for suspending them with a cord. Only at a later age, apparently, were these weights put on the balance pan. See Fig. 1.

More familiar are *Iron Age, Weights and scales in Etruria* by Maggiani. The Etruscans knew both the libra [equal arm balance] and, from the 4th century BC, the statera [steelyard]. The paper tries to determine the standard unit of the Etruscan system that should centre around a Libra of 290 grams and its half of 145 grams. There are beautiful illustrations of three steelyard poises, two with two faces and one with an Etruscan inscription.

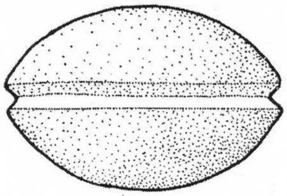


Fig. 1. ▲▲ Lenticular weight found in Emilia of 533g (page 42).

The paper by Cattani, *Stone weights in Etruscan Po Valley*, weights found in Marzabotto (an important Etruscan town near present-day Bologna) of which 57 are still extant. Made from river stones, many are marked with signs related to a decimal system with a unit of 370/379 grams, and ranging from a minimum of 1.1 to a maximum of 38.3 grams.

Weights & measures in trade, arts and crafts, and professions by Corti deals with Roman-period weighing in archaeological representations. Interesting sculptures show the interior of workshops, like a bronzesmith's or goldsmith's or retail shops, a butcher's or wine handler's; they show both equal-arm scales - many with rider poises -and steelyards. A nice sculpture, in the Museum of Dresden, representing a butcher's shop, shows a steelyard with a poise in the form of a head like ones found in Pompeii.

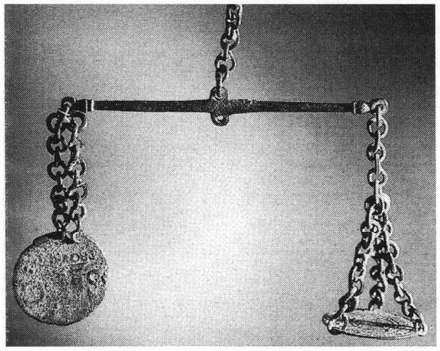


Fig. 2. ▲▲ Coin balance for 1 Tiberius found at Pompeii (page 183).

Weights and measures in Roman age mythology by Corti deals with the mythological figures associated with the scales: Aequitas, Iustitia and Nemesis. An interesting part is dedicated to psicostasia [weighing the soul], familiar from mediaeval frescoes. The first representations - utilizing equal-arm scales - go back in Greece to the 6th century BC. and to even earlier times for Hittites and Egyptians. Very peculiar is the reference to the god Kairos [god of opportunity], shown with long hair only on the forehead, but bald in the back, meaning that you have to grab your opportunity immediately, for, if you wait, you will miss the occasion. The author says the god is shown regulating a balance with pans placed in equilibrium over a razor. I see it differently: The beam, in precarious equilibrium over a razor blade, suggests the precariousness of luck; and instead of regulating, the god seems to be altering deliberately the equilibrium of the balance with his finger, meaning that, if you grab the opportunity, the balance will be tilted in your favour.

Tarpini's *Equal arm scales and steelyards* deals with Roman libra and statera. The biggest scales were made mostly of wood and this accounts for the scarcity of remains (the beam of Boscoreale was 220cm, and high in proportion, judging from the metal parts that are remaining). The smaller scales were mainly of bronze. A very interesting coin scale has, instead of a pan, a fixed counterpoise, a Tiberius weight in this case, used to weigh only the one coin. See Fig. 2. Another kind of coin scales has the poise in the form of a small head, like the one illustrated in Kisch, *Scales and Weights*, 1965, p 47-48.

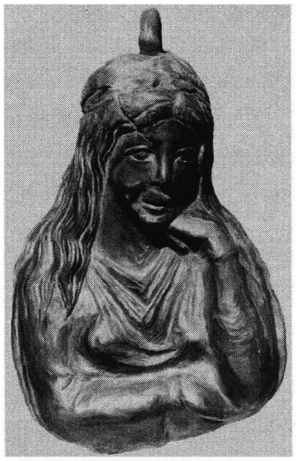


Fig. 3. AA Counterpoise for a steelyard (page 208).

Also interesting are equal-arm scales with graduated beam and rider poise that merged the equal arm scale and the steelyard, in that the difference in weight between the two pans (one for weights, the other for the load) could be finely determined by moving the rider along the beam then reading the graduations. The paper contains a description of the Roman steelyard, presenting specimens of two and three sets of graduations and mentioning the existence of ones with four sets. The bismar was used in Roman times, an interesting one being in the State Museum of Berlin.

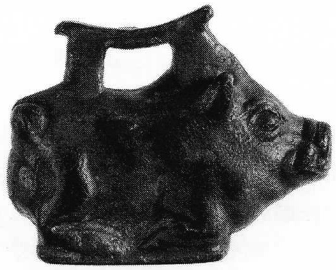


Fig. 4. AA Bronze weight for 150.6g. (page 350.) A 5 once weight.

Corti's *Weights and counterpoises* deals with the verification of weights in ancient Rome as shown by inscriptions like **EXACT**(a) **IN CAPITOL**(io) [verified in the Capitol]. Verification could also be attested by inscriptions mentioning either the Emperor or the public officer in charge of controlling the weights. Firstly, we have inscriptions mentioning **TI.C**(laudius) **CA**(esar) **AUG**(ustus). Secondly, the reference is often to the Praefectus Urbi: **EX AUCTORITATE Q**(uinti) **IUNI RUSTICI PRAEFECT**(i) **URBI**. Weights (truncated sphere, squares, animal forms like pigs or goats, astragals) are shown, with an analysis of the signs indicating the weight. The section on poises is aesthetically rewarding, since outstanding ones are illustrated. Regrettably, the Byzantine poises in the Museum of Archaeology, Istanbul have been ignored.

The last part of the book deals with finds in the Po Valley. Interesting illustrations in *Equal arm scales, steelyards, weights and counterpoises in the Modena region* by Corti, Pallante and Tarpini, include bronze or lead poises in the form of heads or amphora.

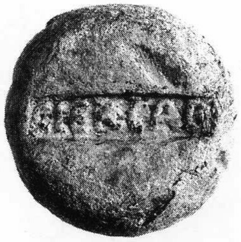


Fig. 5. AA Lead weight of 78.2g. (p 351.) Probably a 3 once weight.

At the end of the book is a catalogue of 54 objects (weights or measures) shown in the exhibition. I would choose for myself no.38, a five pound stone weight in the form of a truncated sphere!

The book is highly recommended even for non-Italian readers. At 31.00 euros you will be satisfied just with the pictures! If the book entices you to learn Italian in order to read it, it will have served two purposes.

G Zavattoni

Response to Review

BY GARY BATZ

Poids Monétaires pour monnaies non françaises *by Aimé Pommier was reviewed in EQM pages 2553-2555. I agree with the reviewer that this book is an admirable achievement, given the fact that the author has covered the intricacies of the metrological systems of several countries as well as the historical context. Nevertheless, I would like to remark on points that fall short of the high standard I had expected. My comments are added to the catalogue number in question, unless I refer to a page or a box in the annexes.*

As an introductory comment, it is disappointing that not all weights have been photographed and some reverses are not shown. This was excused on the grounds of their poor condition. However, in the case of weights whose reverses are referred to as fibreux [fibrous or stringy], they may well be of Cologne origin, since we know from the process of pouring molten brass on steel/iron surfaces, the reverses do in fact look fibrous. This reinforces identification in cases where there is definite proof of Cologne provenance through their being found in named or dateable boxes. Nuremberg, similarly, produced blank reverses, but here, we can see a very fine reverse that differs notably from Cologne workmanship.

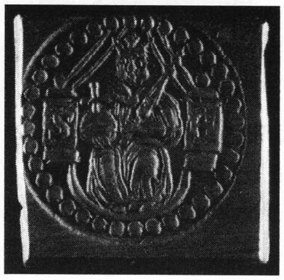


Fig.1. ▲▲ Half sovereign, Henry VIII sitting on his throne. The Dutch and Germans called this a weight for the 'Sitter'. Required mass 6.22 g. Possible Cologne.

Gary Batz photo

Page 14 states that the period of the crowned **I** countermark ended in 1650, a year after the death of Charles I. It seems to me that crowned **I** was not used after 1625, the death of James I.

621 is a case of a missing picture: Elizabeth I coin-weights are extremely rare. Even a picture of a very *brouillée* [blurred] weight would have been preferable to none. The letters **E** and **R** have at times stood for Edward and Rose Noble. The mass of the weight is 91% of the required mass, thus a respectable weight worth showing.

623 and 613 are *ryals* marked **RN** which definitely are known marks of identification of Cologne weights for the Rose Noble.

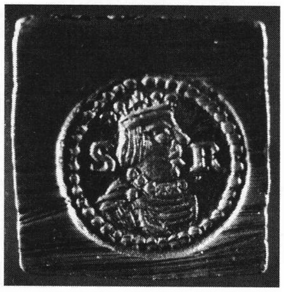


Fig. 2. ▲▲ Half sovereign, Philip IV of Spain. Coin dates from 1621 - 1665. Date and maker unknown, possibly Cologne. Mass 5.51 g, could be used for Edward VI and James I coins on which this coin is based.

Gary Batz photo

628. The date of (15)30 is a misreading, as dates were not used in Antwerp before 1576. Also, this type of wreath was not then in vogue, and I date it (15)80.

642. This weight is for the sovereign of Edward VI with a required mass of 11.31 g, from his issue of 1552 [Grueber 462, Seaby 2450]. **SR** is an acknowledged abbreviation for **S**ove**R**eign. The young king wears an imperial crown.

643. This is for the *Gouden Dukaton*, a coin of Philip IV of Spain for the Southern Netherlands. This coin was continued as the double sovereign

with the mass of 11.1 g. The reference for the Gouden Dukaton is in Houben *Nederland* 28b.8. See Fig. 2.

645. This is for a half-sovereign of Edward VI or James I. Both coins were about 5.55 grams. James I was a Stuart, but also a Tudor and this is the Tudor rose by his nose, but, early in his reign, he abandoned the Tudor rose on his coins. This aspect has led to many confusions about these weights. There are very few weights for Henry VIII for which the Netherlanders made coin-weights as they considered many of his debased coins only worth using as bullion. I repeat, Elizabeth I coin-weights are extremely scarce.

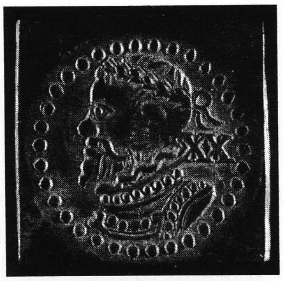


Fig. 3. ⮝⮝ .Half unite James I from 1619 on. Jacobus Heuscher, Cologne, c.1650. Mass 4.55 g.
Gary Batz photo

657. It takes a leap of faith to consider this to be a Unite of James I; the Tudor rose was 5-petalled, it is true, but the author gives no reason for his attribution of this crude flower as a Tudor rose. See 640.

672. The use of **XX** on a 10 shilling weight is no manufacturer's error; it is a well-known fact that dies for the larger coin-weight were also used for the subdivisions. This saved die-makers' wages. Antwerp, Holland and Cologne makers all did the same. See Fig. 3.

677. The same story, using the die for the **XX** for the V shilling weight.

683. (It should be mentioned here that lately all purported English coinweights that show lis [fleur-de-lys] on the reverse are considered Dutch imitations. This is believed to have led in 1632 to the Royal Command to make all weights round from then on. This reviewer has seen the evidence in Holland in 1998 and wrote about it in *Meten en Wegen* pp. 2424 and 2495. Similar views are held by Paul Withers, see Simmons Galleries coin-weight auction *Mailbid 21* of December 2001.)

685. This seems a guinea, indeed, but on the maladroit reverse we have trouble envisaging the virgin maiden of Ghent. The reverse of the weight is clearly double-struck. But why is the obverse not double struck? The author would have satisfied me if he had disclosed how he sees *La Pucelle de Gand* on this weight.

688 and 689. GD? Why not **CD**, for Gerard de Corduanier of Brussels? He was the only South Netherlands maker using round weights. See also further on in this catalogue where he is correctly marked as **CD**. [More about makers can be found in Wittop Koning and Houben's *2000 jaar Gewichten in de Nederlanden.*]

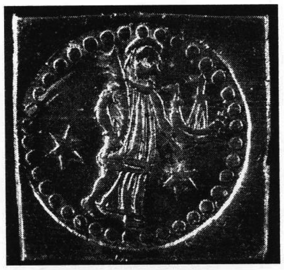


Fig. 4. ⮝⮝ Portuguese 2 cruzado from 1555 showing St. Vincent with ship and palm in hands. Jacob Drielenburgh, Amsterdam, ca. 1650. Mass 7.62 g.
Gary Batz photo

768. [Someone made Saint Vincent into a cute li'l devil with halo. My comments in parenthesis are spontaneous remarks, not critical of the author]. See Fig. 4.

771. Dutch initials are tricky. Their order is not always predictable. This one used **WLA** to write his name, **W**illem van **LA**ngenberch, but the initials appear as WAL from left to right. The author did not see the A below.

772. This maker was **ITW**, note the VV for W. He was Isaac te Welberg, formerly of Antwerp, latterly of Amsterdam.

866. [It is surprising to find these 4 annulets on a 2 reales weight. They also appear on weights of higher and lower denominations and other weights. Netherlands around 1600, but probably before.]

871 and 872. The author questions whether these are lead; I think they probably are, as their shape seems to indicate a soft metal like lead. Netherlands before 1600.

881 and 893. These are by **ADB**, or Adolf de Backer II of Amsterdam.

892. A picture of this reverse would be welcome, however illegible. This is probably written **LVG** with a high V, as in Lenard van de Gheere, a family, all four generations having the same name, whom I have studied for a number of years, and about whom I shall be writing in the near future, unravelling the differences on the reverses of the weights.

Pages 59 to 64, weights 906 to 957. Now I am on familiar territory. The Spanish coins for the gold *escudo* (pistole) series and the silver *reales* of piece-of-eight fame came about in 1537 under Emperor Charles V. Both were based on the mark of Cologne then in use in Spain, but Senor Josep Pellicer i Bru, author and present president of the Spanish Numismatic Society, assures me that, in Spain, the mark weighed only 230 grams at that time and not 233.85g as in Cologne. The ounce or onza weighed one eighth or 28.75g. With the gold piece of 8 *escudos* worth $16 in America or 16 pieces-of-eight in silver, we have a 16:1 ratio. Continuous supplies of gold and silver from her Spanish colonies in South America changed the ratio, and eventually what was to be an ounce of silver or gold became a different quantity in terms of the mass of the coins. Nevertheless, some authors suggest that the prescribed mass of the largest pieces of gold or silver was 27.4680 grams between their earliest minting and the year 1728, and 27.0642 g thereafter. Pommier correctly distinguishes between them as *premier* type and *deuxieme* (second) type.

Now to separate gold from silver: Gold *escudos* of all denominations show the cross of Jerusalem or *cross potencée*; it has extensions at its four extremities (that the Germans call crutches, hence their appellation of *Krueckenkreuz*). They also bear the inscription *pistol*[*e*] at times. Quadruple? That means a gold 4-fold *pistole* or 8 *escudos*. Confusing? Yes, they changed the rules along the way: double became quadruple. (See heading for Quadruple ecu, where the author says "double pistole ou [or] quadruple pistole".) Silver coins have a shield with lions and towers. Sometimes the lions look the wrong way, to the right. It's that easy.

It is more difficult to deal with the weights inscribed **DOBLA** [Italian for double] as often it is unclear whether this means the gold or the silver coin. Then we have those inscrutable weights inscribed **VIII 18** and **4 R** (weight 940) and **XVII** and **8 R** (weights 956 and 957), sometimes with that off-putting VR stamp, but I am on their track and will soon write about them as American-made weights for the Spanish dollar in use here during colonial times. The main task will be to differentiate between those made for New York and the West Indies. These two series of coins were the most durable in all of Europe and around the world in the 17th and 18th centuries and beyond, hence so much material to be viewed here.

912. This weight was made in Liege, today's Belgium, another home of the (otherwise Nuremberg) lion scales, the ones in boxes with drawers, complete with scale on a standard and lion on a string. See Houben *Nederland* 25a.10. Yes, Theodore of Bavaria, prince-bishop of Liege/Luttich/Luik, then a separate country almost completely surrounded by the Burgundian Netherlands. The introduction to The Netherlands section shows that in the South the mark was subdivided into 192 deniers of 24 grains, while in the North they had 160 engels of 32 asen per mark. Contrary to Dieudonné and Pommier, the Amsterdam troy mark weighed 246.084 grams.

1006. As in the 1552 Ordinance, which for the first time shows effigies of coin-weights, this photo is also upside down. The weight shown is a florin of Florence, and not a Guillelmus or *ecu* [shield] of William VI, count of Bavaria in his capacity of 4th count of Hainault, Holland, West-Friesland and Zeeland. See Fig. 5.

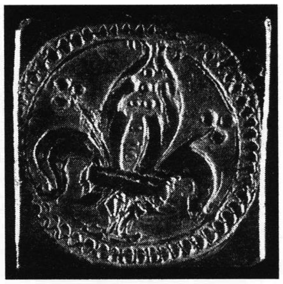


Fig. 5. ⮝⮝ Florin of Florence, first European gold coin after the Dark Ages. Cologne c.1650. Dutch tolerance mass in 1586, 3.41 g.

Gary Batz photo

1015 and 1016. Both are Friesian Riders, marked **FR** and **VRIS** in the exergue [a small space usually on the reverse, below the principal device, for any minor inscription, the date, engraver's initials, etc], respectively, for an imitation of the French *ecu d'or*.

1028 and 1029. There is nothing to distinguish this weight from a Noble of the Henrys of England, made in the occupied France during the Hundred Years War that ended 1453. The next weight is indeed a Burgundian half-noble, the **S** by the mast standing for *Schuytkin*, old Dutch for little ship.

1037. The taille for this weight reads 541/2, the half being expressed by a lower case **z**. *Taille* is the number of coins the minter produced from a mark of gold. This weight (and the one above and several others) is based on the Burgundian Ordinance of 8 Dec, 1499, of Philip the Handsome, married to Mary the Mad and father of Charles V.

1042. I suggest this reads **PVG** for Pieter van den Gheere, another one of the above-named family. But this is uncertain.

1043, 1076, 1078 & 1079. More by **WLA**, Willem Langenberch, see above.

1045 and 46. *Cantonée* means there is something in the angles, such as of a cross. I fail to see two towers and two double eagles on either weight.

1054. Looks German-made to me, just another German or Hungarian ducat which, admittedly, would weigh the Dutch ducat as it was made to the standard of the Empire.

1084. **GDM** is **G**illes **D**el**M**otte whose verification mark was **GM**, not CM.

1086. The author believes this weight is 2.45 grams short in mass. Its initials **KD** flanking Philip IV stand for *Koningsdaalder* [king's thaler]. The maker is Jacob de Neve [IDN] whose famous father, Guilliam de Neve, made distinguished boxes with silver weights that are rare objects of beauty. Alas, there is no $^1/4$ king's dollar which would fit the mass of the weight, 8.59 grams; there is only $^1/5$ dollar, a half and a tenth. Can't think of another weight with that mass.

1096. There was no quarter sovereign, it is a half, see Houben *Nederland* 27d.

1116 and 1120. **V** is for Vngar. Ducat, not Venice. The Nurembergers used V on most of their Hungarian ducat weights. The Hungarian ducat provided the European standard.

1117. Along the same lines, the inscription **1/V/DVC** stands for 1/Hungarian/Ducat.

1118. Here the Ungar. Ducat is signified by **U**.

1194. This weight from Zeeland is also in my collection, with the same die break. Arent Pol's book, *Noord-Nederlandse Muntgewichten* calls this a *fiorino da camera*, its name in Italy.

Plate 33. In the first paragraph under the Table it says the letter U is indicated by the letter Y. Please read that as **V** for standing for U.

Box 1. This most handsome box shows weights for 26 gold and silver coins. Such mixed weights boxes are extremely rare. Look at the finely wrought hooks! What happens if the handle on the right is pulled, another layer of weights, perhaps? This and the other boxes contain weights that are not shown in the individual identification section. Pity. I still have problems with those so-called *Pesos de Portugal*, as the strange icon of a cross is not represented in Davenport's catalogues of 17th and 18th century silver coins of Europe. The mass of the largest is 1 denier (1.2747 grams) less than that of the Spanish piece-of-eight, in the lower right corner, with the bundle of arrows. Why has this box no room for the scale? Aha! Maybe it was originally in the pull-out department below. Very clever!

Box 2. By André le Fran. There are two weights missing which the author indicates with a [p] for *perdue* or missing. The weight for the half of the quart' ecu is to the right of the pans, with its cross ending in lilies! The larger quart' ecu, right below it, occupies the space labelled Teston. The teston [meaning head, and this is a pretty head indeed] is only 2 grains lighter than the quart' ecu and thus was placed in the wrong cut-out. The same for its half, below. Pity. It is good to see boxes arranged in good order before photography commences. Last, but not least, the author does not mention the half quart' ecu at all in his listing of the weights. Pommier's Book 1 has a clearer picture of this box on page 18.

Box 3. The author places the manufacturing date as between 1705 and 1710. [The dates of 1689-1773 refer to a poet from Dijon, not the date of the box.] I disagree. The youngest weights are those seven lookalikes on the right. They show Louis XIV, born 1638, as he is on his gold and silver coins of his younger years, 1644 with "short curls", and to 1653 with "long curls" of hair. The mass of 10d 12gr given by the author (from the reverse of the weight) is the earliest known tolerance mass of the double Louis "with the 8 letters L". Those weights with the medieval-looking king with "open crown" were long out of circulation by 1705. By then Louis had already reduced the mass of his silver ecus (dollar-size coins) at least twice. Note the ingenious way of securing the often-missing lid of the grain-locker!

Box 4. This Cologne-made box shows a veritable salad of mixed weights. Seven of the 22 weights are lodged sideways or reverse up. The so-called Noble of Burgundy is probably just a Henry Noble. The **FC** above it, lying sideways, is just a French crown (not of the sun as the distinguishing sun image is absent). The reverse-up weight from Mons (with the city's towers) intrigues me, but I don't know which it is in Pommier's listing. In the upper left corner is the Rose Noble with **RN**, see my notes above. Only ten coin-weights have been identified. I also see a half real of king Philip II marked **HR**, a Hungarian Ducat marked **HD**, a Gold Real of Charles V marked **GR**, an excelente (or double) with their Catholic Majesties facing one another, a pistol or multiple with the cross of Jerusalem, a rose noble or ryal with rose on ship, and an angel with Archangel Michael slaying the dragon. Those two dark pieces that do not fit in with this crowd have the letters **DVX**; perhaps they deserve further study. Otherwise, the style of most weights is Cologne. See Fig. 6.

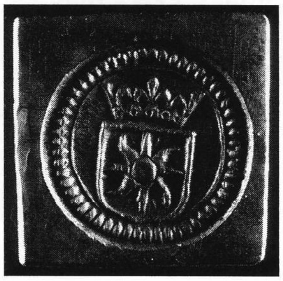


Fig. 6. ▲▲ Ecu d'or au soleil, in England called 'crown of the sun', [in Holland: 'zonnekroon']. Lyon, France about 1668. Dutch tolerance mass in 1586, 3.41g.

Gary Batz photo

Box 5. This very plain box from Berg has a Nuremberg scale beam that is too short. The so-called Horse of Hanover verification marks are, instead, what the Germans call the *slim lion*, to set it apart from the *fat lion*. Hanoverian marks are very rare. Three weights are from another maker, as they have no lions. **NS Ls.DOR** stands for the New Shield (French) Louisd'or of 1786. The **1 AS LsDOR** probably had a tolerance allowance of 1 German As. Confusing? The merchants knew what it meant, and that's all that counts. The author also forgot to list the CARLIN and its half.

Box 6. This fine box is dated 1628 and bears Guilliam de Neve's label that includes a panel of Death, the merchant and his wife. All around the panel are images of coin-weights, not coins. The list shows a half-sovereign of Elizabeth I, its half and another (unspecified, unfortunately, and not illustrated) sovereign of England. I have my doubts about these being weights for Elizabeth's coins. It would have been a great help if all these weights in the boxes had been identified and pictured, as in the catalogue.

The author shows an impressive bibliography on page 137 and it is assumed that he has worked with these books extensively as we can see the results of his efforts. Without these books it would not have been possible to produce such a fine work. Despite all these comments we have a workable catalogue of weights. Now off to Paris to see them all!

US Patents, 1871-1873

Text by R HendricksWillard

Captions by D Crawforth-Hitchins

The years following the Civil War were tumultuous. Reconstructing the Union--re-uniting the 37 states-- was something like putting Humpty Dumpty together again. The pieces were there, but they no longer fitted together making a familiar whole. The South was in ruins, its cultural traditions and strong states-rights beliefs discredited. Having failed to secede, what must these rebels do to regain full statehood? What should be the status and rights of the former slaves? Who was eligible to hold public office? What about reparations? It was five long years before all 11 seceding states had mustered the required majority of voters to accept the conditions imposed by Congress for re-entry into the Union. During that period more and more people were leaving the farms to settle in towns and cities. There they entered trades or industries which required innovative tools and equipment that could be tended by unskilled workers who need not read English.

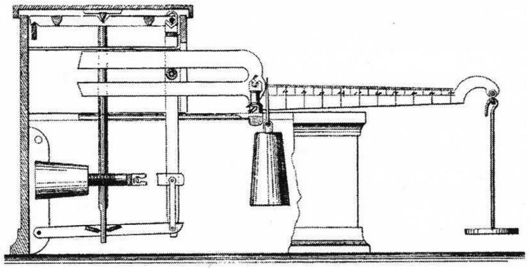


Fig. 1. ▲▲ DD Allen's patent no. 114248 of May 2, 1871. Counter steelyard. The whole beam slid along to the right to the point where it indicated the price per pound of that load, then the poise was moved to obtain equilibrium, at which point, it indicated the price of the load.

Floods of eager inventors successfully patented devices to satisfy this new market. The country that had issued 10,000 patents in its first 46 years issued nearly 16,000 in 1866 alone. The Patent Office was overwhelmed.

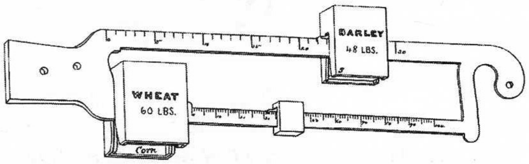
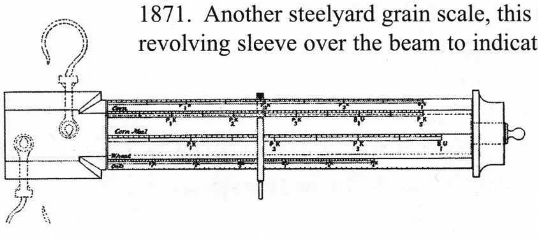


Fig. 2. ▲▲ H P Wheeler's patent no. 114,737, of May 9, 1871. The top beam was graduated in bushels and the lower in fractions. The poises were labelled for the grain being weighed. The two lightest poises were on the beam permanently, and the poises for denser grains slotted over the poises for the less dense grains, so that the multiple poise was correct for the denser grain. Poises were supplied to suit the grains being weighed.

Fig. 3. ▼▼ H Kirkwood's patent no. 118,862 of Sep 12, 1871. Another steelyard grain scale, this one with a loose revolving sleeve over the beam to indicate the bushels.



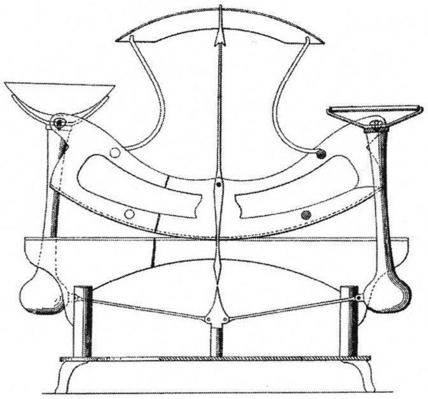
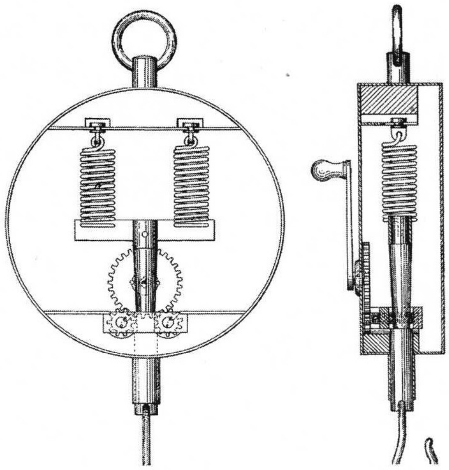
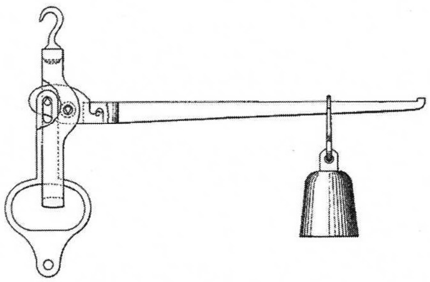


Fig. 4. ◄◄ F G D Holmes patent no. 128,397 of Jun 25, 1872. This counter scale rocks, and the pendulous pointer swings along the graduated arc to indicate the weight. The pans are held horizontal by schickert's principle masses below the pans. Probably not manufactured!

Fig. 5. ►► J E Thomson's patent no. 128,677 of Jul 2, 1872. Arrestment of the spring balance is achieved by having a clamp on the vertical rod that is released by turning the handle, thus putting the load onto the rod and thus also onto the spring.





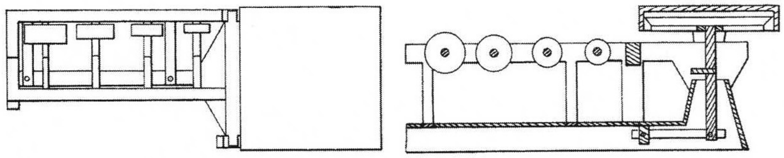


Fig. 6. ▲▲ T C Hargrave's patent no. 135,908. The hoist, comprising the two links at the left, could be converted to a steelyard by inserting the beam and moving the poise along to the right. This action lifted the load, and the bearings would take the weight. Thus the mechanism operated as an arrestment.

Fig. 7. ▲▲ S Harris' patent no. 141,556 of Aug 5, 1873. Harris was concerned with the potential loss of weights or poises from counter scales, and devised a set of pegs in line with the beam, whereby the captive poises could be slipped across from their storage position, directly onto the matching pegs on the beam.

New situations needed to be addressed. Congressman Jeneckes of Rhode Island (whose fifth-great grandfather received the first patent in America from the Massachusetts Bay Colony in 1646) was a patent attorney and chairman of the House Committee on Patents. After several failed attempts, on July 8, 1870, Congress ratified a bill that thoroughly amended and codified the patent laws. This bill improved appeal procedures, defined the time when rejected applications became abandoned and not subject to further prosecution, and allowed a party sued by a patentee to win the suit by having the patent declared invalid. For the first time, the law permitted the registration of trademarks by the Patent Office. Encouraged by advances in technology and the obvious prosperity of numerous patentees, many others rushed to patent their own ideas for improvements in scales.

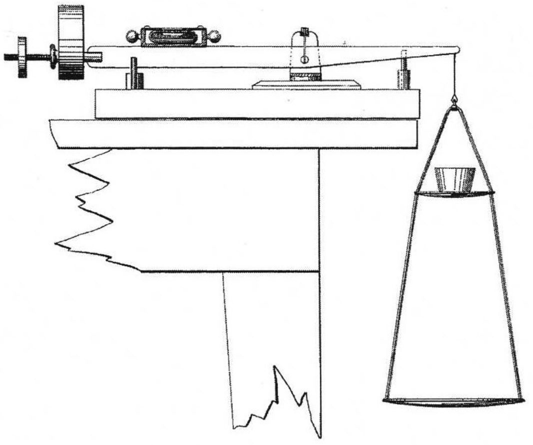


Fig. 8. ▲▲ E Pickering's patent no. 144,286. Shelf-edge torsion balance!! The beam was held between two watch springs that twisted when the beam tipped, and the pan was suspended from a length of watch spring. All the weights were put in the upper pan and the spirit level indicated when equilibrium was achieved. The load was put on the lower pan, and weights removed until equilibrium was again achieved. The sum of the weights removed indicated the weight of the load. Intended for scientific investigation and general purposes.

Patents sorted by date, (shop/warehouse platform scales and smaller). 1871-1873

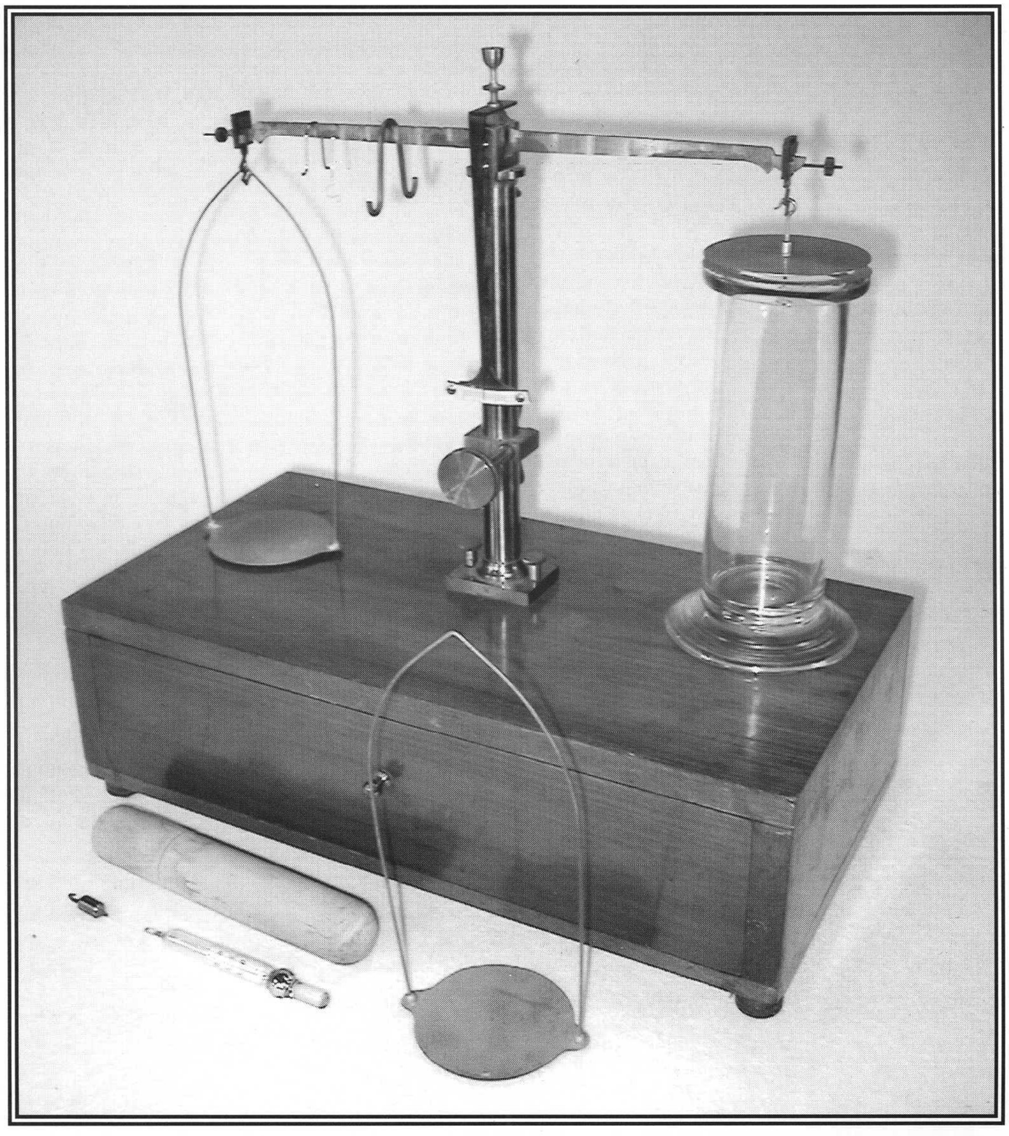
NO.	DATE	INVENTOR	RESIDENCE	ASSIGNEE	TYPE
110,696	Jan 3, 1871	J H Truex	Rochester, NY		Stirrups for bearings
110,707	Jan 3,1871	C A Welan & C T Wakeley	Madison, WI		To lower load under steelyard
112,043	Feb 21, 1871	O D Hudson	Waupun, WI		Hydraulic sc ribs, for grain
112,522	Mar 7, 1871	W Zimmerman	Lebanon, PA		Platform Sc with bag holder
113,529	Apr 4, 1871	M Kennedy	New York, NY		Bearings under platform sc
113,543	Apr 11, 1871	W H McCormick	Muncie, IN	self & J Williams	Weighing on carts
114,248	May 2, 1871	D D Allen	Adams, MA		Computing counter steelyard
114,737	May 9, 1871	H P Wheeler	Rochester, NY		Chondrometer w several poises
D4874	May 9, 1871	P Cinquini	Meriden, CT	Charles Parker	Ornamental design for base
115,419	May 30, 1871	W Black	Adams, MA		Holder-rod for steelyard
116,999	Jul 11, 1871	G Scott	Montreal, Canada	H R Ives & R N Allen	Postal roberval w string box
118,678	Sep 8, 1871	N Berkeley	Brooklyn, NY	W Berkeley & C B Wildman of Leesburg, VA	Carriage jack, bag-holder, spring bal
118,862	Sep 12, 1871	H Kirkwood	Americus, MS	A Kirkwood	Tubular sleeves on steely'd to indicate by bushel
119,871	Oct 10, 1871	C C Marsh	New York, NY		Equal arm beam to operate as calculator for accounts
120,927	Nov 14, 1871	H Andres	Troy, NY	self & S R Andres	Weight -lifting platform sc
121,200	Nov 21, 1871	E Sampson	Nasau, NY	E Sampson, S R Andres, & H Andres	Platform sc
121,420	Nov 28, 1871	W W Reynolds	Brandon, VT		Beam-graduating machine
122,045	Dec 19, 1871	F Meyer	Newark, NJ		Machine for forming scale pans
123,564	Feb 13, 1872	J B Hendricks	Clayton , IL	self & J Bryson	Adjustable bearings on platform sc
128,397	Jun 25, 1871	F G D Holmes	Phillipsburgh, NJ		Top-pan counter sc with pendulous masses & rocking fulcrum
128,677	Jul 2, 1872	J E Thomson	Buffalo, NY		Arrestment on spring bal
5082	reissue Oct 1, 1872	S Ingersoll	Brooklyn, NY	J Hollely & J Ryer	Taring spring bal
134,034	Dec 17, 1872	J Cobleigh	Morrison, IL		Sc & dumping platform combined
135,908	Feb 18, 1873	T C Hargrave	Boston, MA		Hoist & steelyard
138,315	Apr 29, 1873	H T Budge & N W Russell	Cedar Falls, IA		Bagholder & steelyard
138,362	Apr 29, 1873	J Baggs	Easton, MD		Butcher's knife, saw, & spring bal
139,372	May 27, 1873	A Cyrani & C Reinhart	Brooklyn, NY		Arrestment on equal-arm apoth
141,556	Aug 5, 1873	S Harris	Philadelphia, PA		Laterally-shifting poises on counter steelyard
141,627	Aug 12, 1873	J Bryson	Quincy, IL		Lever design under platform
142,991	Sep 23, 1873	W Z Conner	Shelbyville, IN		Hydraulic Counter Sc
143,499	Oct 7, 1873	J P Chatillon	New York, NY		Flange on pans
143,658	Oct 14, 1873	A H Bell	Cedar Falls, IA		Bag holder & steelyard
144,286	Nov 4, 1873	E C Pickering	Boston, MA		Shelf-edge torsion steelyard with spirit level for fine weighing

ISASC®

EQUILIBRIUM®

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

2002—ISSUE NO.4 PAGES 2729-2756



Cover Picture

This specific gravity balance was made in the early part of the 20th century, possibly in Germany, for the British market. The trade mark is an eagle flying to the right, grasping the pole of a flag in his claws, with the flag fluttering up behind him.

The 9ins brass beam has notches numbered 1-9 , to enable the user to add up the sum of the poises as explained on page 2733. The glass cylinder is made of a heavy glass that can withstand liquids of 15°C. The temperature is checked using the thermometer that is stored in the wooden case that lies along the front of the drawer.

An extra pan is supplied so that the balance can be used as a conventional laboratory balance. Fine wire is supplied so that extra poises can be made.

All the equipment can be stored in the drawer, but, with no inner fittings, it is difficult to store them without causing damage next time the drawer is opened. See pages 2731 to 2735.

Editor's Comment

This issue has an exceptionally large number of drawings because the scales under discussion are so rare that few photographs are available.

ISASC
INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

EQUILIBRIUM is published quarterly in January, April, July and October

© 2002 International Society of Antique Scale Collectors ISSN-0893-2883

International Society of Antique Scale Collectors
Founded September 1976
Internal Revenue Service 501 (c) (3) EIN 36-2976411
3616 Noakes St., Los Angeles, 90023
Tel 323.263.6878 **Fax** 323.263.3147
www.isasc.org Thomas_Dooley@bbs.macnexus.org

Directors and Officers 2002*

President	Thomas Dooley*
Vice Presidents	Steven Beare*
	Jerome Katz*
	Ruth Hendricks Willard*
	Gerald Wilson*
Secretary	Norman Cima*
Treasurer	Edward Konowitz*
Executive Secretary	Jan Macho
President Emeritus	Bob Stein

For membership information contact
Steven Beare stevebooks@aol.com
7 East Brookland Avenue, Wilmington, DE 19805

Published with the co-operation and support of

ISASC Europe
Founded October 1993
Charity commissioners for England & Wales No 1037558
P.O. Box 179, Headington D.O. Oxford OX3 9YP

Trustees and Officers 2000-2002*

Chairman	Michael Robinson
Treasurer	Ken Govier*
Secretary	Phil Holroyd*
European Representative	Serge Camilleri
Meetings Secretary	Janet Scarratt*
Publications Officer	Roy Ladell
Trustee	
Information Officer	D Crawforth-Hitchins

For membership information contact
P.O. Box 179, Headington D.O. Oxford, OX3 9YP, UK

Editor: Diana Crawforth-Hitchins, **Tel** +01865 763096 **Fax** 01865 751797 les.hitchins@bcs.org.uk
Associate Editor: Ruth Hendricks Willard, **Tel** 415.566.9670 **Fax** 415.566.3666 rhwillard@aol.com

Hydrostatic Weighing

BY P BUCHANAN

Fraud

Archimedes of Syracuse is said to have discovered the principle of hydrostatic weighing about 250 BCE, when he was asked to investigate a possible fraud in the purity of the gold used to make a crown. As the King of Syracuse insisted on non-destructive testing, Archimedes compared the displacement of the crown (apparent loss of weight when in water) with the loss of an equal weight of pure gold. This method of quality control could be applied to other items of value, including coins.

Counterfeit coins are as old as commerce itself and their existence has always caused concern because they undermine public confidence in the value of the currency on which trade itself depends. Coiners, despite severe penalties, clipped the edges of coins and alloyed the scraps of gold or silver with cheaper metals to make new coins. At times, these practices were so widespread that little full-weight genuine currency remained in circulation[1] Coin scales were widely used as a quick and simple way of checking the gross weight of coins, and hydrostatic weighing was done sometimes, to discover whether base metals had been mixed into the metal of coins. This form of double weighing was considered such an important subject that the technique was included in demonstrations of scientific experiments given by lecturers such as Francis Hauksbee and published in the early 18th century.[2]

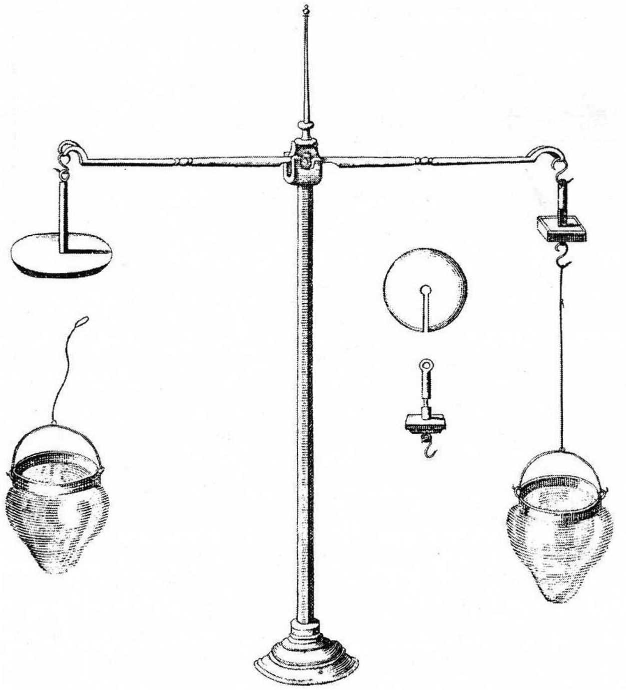


Fig. 1a. ▲▲ The scale is set up to weigh solids in the glass bucket in air, with a slotted weight to put on the right-hand square pan when the bucket is eventually submerged. The left-hand pan is preloaded to balance the empty bucket. Any cylinder could be used to submerge the bucket, but usually, at that period, a glass cylinder was provided in the box. Additional grain weights were in the box, to find the exact apparent 'loss of weight' of the load in water by placing them on top of the poise.

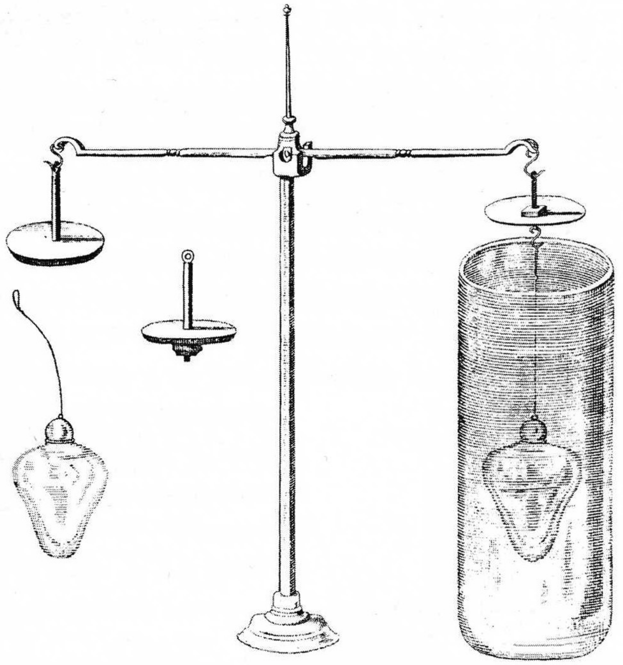


Fig. 1b. ▲▲ The scale is set up to test liquids, with the glass pear submerged in the liquid to be tested. Grain weights were to placed on the right-hand pan until the beam was in equilibrium.

From John Harris' *Lexicon Technicum or the Universal English Dictionary of the Arts and Sciences*, 1710.

Testing solids

Fig. 1 shows an equal-arm hydrostatic scale. As this scale was designed for demonstration purposes, the counterpoises are of known mass, and the pear-shaped plummet and the bucket are made of glass. In use, firstly, the small, fragile glass bucket was suspended from the beam and its mass tared with the poise labelled *Bucket in air* (or similar wording), returning the beam to the horizontal. The sample to be tested was then placed in the tared bucket and weighed in air, the exact weight noted and the bucket emptied. Next, a glass of water was placed under the bucket and the bucket submerged. The buoyancy of the bucket caused the beam to lift slightly, so it was tared with the lighter poise labelled *Bucket in water*. The sample was then slid into the filled bucket without trapping any air bubbles; the whole was submerged and reweighed and the apparent weight loss (due to displacement) noted. The weight in air, when divided by the apparent weight loss, gave a constant for that substance, that is, a fixed value called its 'relative density',[3] that is, its specific gravity.

The relative density of gold is higher than that of other common metals such as copper, so if copper was mixed with gold before casting, the coin would give a lower relative density than a coin of pure gold when hydrostatically weighed.

Once the Relative Density of common metals had been established, these Tables could be used to predict the weight-loss in water of a sample. A piece of gold weighing in air, say, 38 units of weight, must 'lose' about 2 units in water. (38 divided by 2 equals 19.) A piece of copper of equal weight must lose about 4 units. (38 divided by about 4 equals about 9fi). It is the amount of 'lost' weight that is the give-away, and though the figure is more fiddly to obtain than a weight in air, it supplies a valuable piece of analytical information, especially if the answer is surprising!

½

Table of Relative Density

Platinum	21.45
Gold	19.3
Lead	11.35
Silver	10.5
Copper	8.96
Iron	7.87
Zinc	7.13
Aluminium	2.70

Exploration, trade and the discovery of the New World introduced new and potentially valuable mineral resources to Europe, including the unexpected. In the mid-18th century gold bars, brought to London from South America, were found by assaying to contain only 10% pure gold, though their relative density, when hydrostatically weighed, had been so near that of gold that nothing had been suspected. The other 90% bulk of the bars was found to consist of the metal platina, (a white metal that was a mere curiosity, as it proved difficult to work, unlike the gold and silver already produced in Spanish South America). The existence of such a metal greatly interested scientists, but greatly alarmed their governments; in consequence exports of platina from New Granada (Columbia) were banned. Small amounts, however, continued to be smuggled into Europe and, once processing techniques had been mastered, the metal, renamed platinum, with its high density and resistance to corrosion,

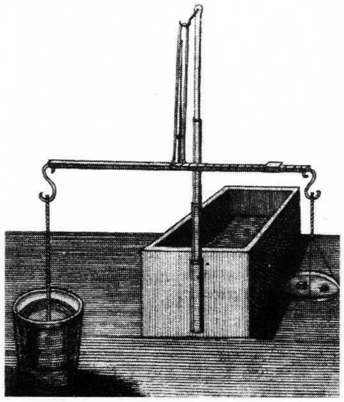


Fig. 2. ≺≺ P M Hahn (1739-1790) used an equal-arm beam with a sliding poise on the beam for hydrostatic weighing. The sliding poise on the beam was superseded during the 19th century, on Mohr's hydrostatic balances, by a set of decimal hooks that could be placed on the numbered notches, giving an accuracy of four places. See Fig. 3b.

[See Hans Jenemann's 'Philipp Matthäus Hahn und die Verwickichung arbeitssparender und bequemer Waagen', in *Blätter für württembergische kirchengeschichte,* 1980, pp142-174.]

Comparative Prices in Frederick Accum's catalogue of 1805

Accurate beams, scales [pans] & weights	£1..1s..0d to £36..0..0
Laboratory Scales	£1..16..0 to £5..5..0
Hydrostatic Balances, (See Adams' *Lectures of Natural Philosophy*, vol III, p 428)	£5..5..0 to £8..8..0
Hydrostatic Balances, improved	£10..10..0 to £15..15..0
Atkins' Improved Hydrometer, (See *Nicholson's Journal*)	£4..4..0

Comparative Prices in W & S Jones' catalogue of 1850

Hydrostatic balances for finding the Specific Gravity of bodies liquid and fluid	£2..12..6 to £10..10..0
Ditto with brass or white metal conical beams with agate supporters, platina pans & weights in glazed mahogany case	£31..0..0 to £52..10..0

was used to make Standards, such as the International prototype kilogramme.[4]

Exploration in remote areas for geological surveys brought a need for hydrostatic scales that were robust enough to be carried by pack mule, to help with identification of rocks. Walker's scale (EQM 2718) makes no claims to high accuracy, (*Hundredths must be guessed*) and relies on the experience of the user. It is an unequal-arm scale with a moving load. The weights in air and water are in inverse proportion to the distance from the fulcrum X, making the equation XY (Y being the reading of the load in water) divided by XY minus XZ (Z being the reading of the load in air).

More accurate laboratory versions of hydrostatic scales were made in the 19th century, Figs. 3 & 4, by Westphal and Mohr amongst others.[5 & 6] Numerous industrial applications were found for hydrostatic weighing, including ascertaining the starch content of potatoes, checking corn, and lanolin in wool.

Testing Liquids

Liquids of different densities could also be compared.[7] In the demonstration scale, Fig 1b, a solid pear-shaped glass plummet was lowered into the water to be used as a standard, and the poise labelled *Pear in Water* used to tare it and level the beam. Other liquids, of different relative densities, caused the pear to rise or fall slightly, and grain weights were added to one pan or the other until the beam was again level. These weights were tabulated, and thus compared. The

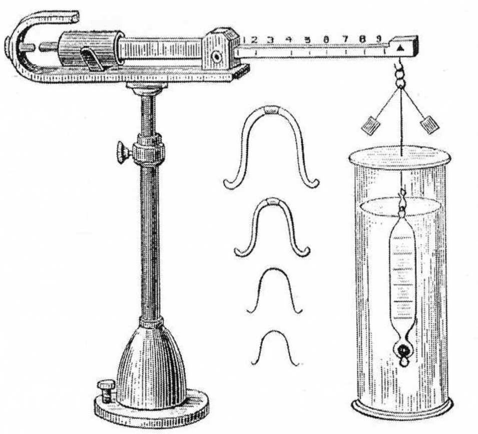


Fig. 3a. ▲▲ K F O Westphal (1806-1879) combined the convenience of a steelyard, quickly tared, and the poises that added up to four places. These hydrostatic scales were offered in catalogues from about 1860 until at least the 1930s. This example is offered in J J Griffin's catalogue of 1913, *complete with a 15 gramme plummet which displaces 5 grammes of distilled water at 15ºC., plus four rider weights of 5, 0.5, 0.05, and 0.005grammes, plus a large weight which, when placed in the the 10th notch, will give equilibrium if the plummet is suspended in distilled water at 15ºC. When the specific gravity of the liquid is less than 1 the unit weight will require to be placed on some other notch.*

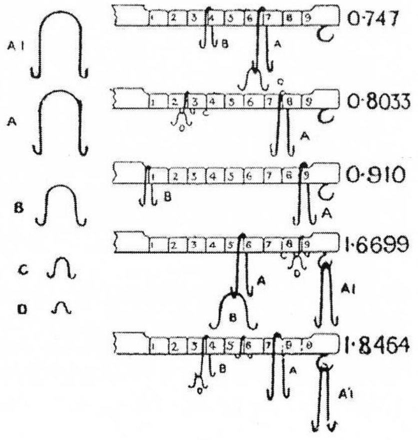
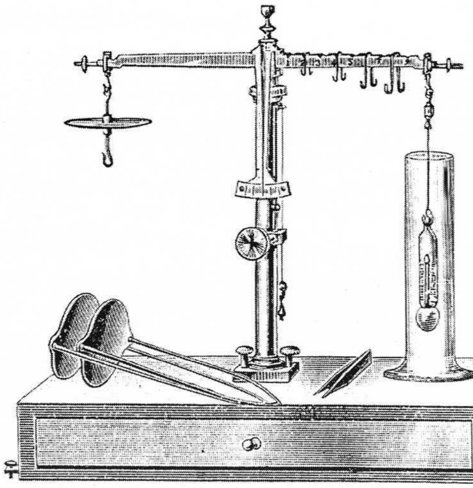


Fig. 3b. ➤➤ *If equilibrium obtains when the large rider is at 7 and the other riders are respectively at 4 and 7, the specific gravity of the liquid in the vessel will be 0.747. For a liquid heavier than water, the duplicate unit weight supplied must be placed on the end hook, and then the other four riders be placed until equilibrium is obtained.*

Fig. 4. ➢➢ Balance Aréothermique, by H L Becker Fils & Co of Brussels, 1913. This Mohr's balance gains the extra title as the plummet has a thermometer sealed inside it, to enable the user to check the necessary temperature (15ºC) easily. Recommended for checking alcohols, essences, ethers, glycerines, oils, acids, alkalis & sugar solutions.



differences in relative density, especially those due to different strengths of alcoholic spirit, were of great importance to producers of alcohol, and also to those responsible for collecting Excise Duty on the product.

To obtain accurate values of alcohol content for the government, the Royal Society commissioned a new hydrostatic balance from the instrument-maker, Jesse Ramsden.[8] It had a 2-foot beam formed from two metal cones, and was found to be highly accurate. Reports giving detailed Tables were published in 1790 and 1792, and in these, a range of mixtures of alcohol and water were compared. It was soon realised that the results, from pure ingredients under laboratory conditions, would not themselves prevent fraud, since a generous addition of sugar in very strong spirit reduced its apparent strength no less than 17%.[9] The Tables did, however, offer manufacturers a standard against which to measure the spirits they produced, at a time when temperature control was difficult and sterilisation imperfect.

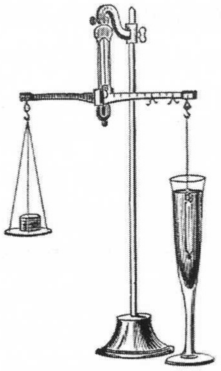


Fig. 5. ▲▲ Specific gravity scale by Henry Troemner, 1899. *Constructed after the plan of Dr. Mohr.*

Routine checks on beer and spirits were carried out using a hydrometer, which acted as a portable hydrostatic scale. Fig. 7. By the mid-18th century the hydrometer had been developed from an early design by Boyle[10] into an instrument with many useful applications. The hydrometer consisted of a hollow metal or glass bulb with a little mass below it (to keep it vertical), and a graduated stem above the bulb for instant read-out. By having a set of little poises that clipped onto the stem, many liquids could be tested. Because liquids had different densities according to temperature, extra little poises had to be added to compensate for temperature. Hydrometers (with various names) were used to check sugar solutions (for beer), brine, the cream in milk, oils, vinegar, chlorine content, or sugar content of urine for diabetes.[11]

Experiment as done by Robert Hooke in 1683

The basic principles of all these scales can be seen by using a spring balance.[12] Attach a chosen load onto the bottom of the balance and read off its weight. Lower the sample into a container of water, and reread the weight. Try a tin of beans, bag of 'copper' or 'silver' coins, or bag of nails etc. This will show

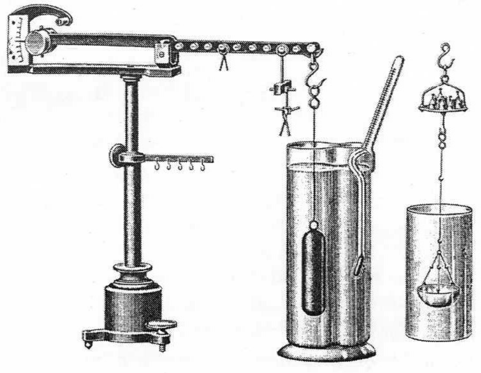


Fig. 6. ➢➢ Rumann's type specific gravity balance by Göttinger Präzisionswagen-Fabrik, 1913. The poises hang on pegs on the side of the beam, said to give greater precision than notches on top of the beam. The thermometer is moulded into the side of the cylinder, with the mercury bulb bulging into the liquid from the wall of the cylinder to give extra precision.

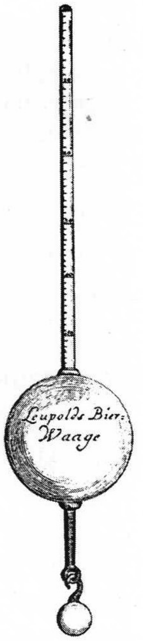


Fig. 7. ➢➢ Hydrometer for testing beer made by Leupold of brass, with a small weight to hang from the bottom. One of many similar designs shown in Leupold's *Theatrum Hydrostaticum* of 1726. Leupold showed some hydrometers that had a tiny pan at the top, onto which minute poises were placed. Some had more than one poise, and graduated scales to siut each. Some had poises shaped like rings that were slipped onto the rod. Some had a pan suspended below the rod into which poises were placed, or the load (metals, minerals or gem-stones) to be tested could be put into the pan. Some were made of glass altho' it was difficult to make and tended to shatter during use, some of brass and even occasionally of amber.

the weight, and the apparent loss in weight due to displacement. If you collect and weigh the water that overflowed, it will equal the 'lost' weight.

Acknowledgements

With thanks to Dr. Brian Gee, B J Oliver, T Allgeier, A Simcock and S Marran.

Notes & References

1. Bryant, A, 1958, *The Age of Elegance 1812-1822*, Pelican, p 96. In 1813, at the end of the Peninsular Wars in Spain, the Duke of Wellington found enough forgers in his army to staff a new Mint and supply the local population with currency.

2. Francis Hauksbee FRS, c.1660-1713, published his experiments, many done for the Royal Society, from 1709 on.

   Harris, J, 1710, *Lexicon Technicum or a Universal Dictionary of Arts and Sciences.*

3. Formerly called Specific Gravity.

4. McDonald & Hunt, *A History of Platinum and its Allied Metals*, 1982. The Kilogramme, made of platinum alloyed with 10% iridium, is now at the International Bureau of Weights and Measures at Sèvres, Paris.

5 F Mohr, Koblenz, physician & maker of instruments & measures, 1833-1890. Exhibited at Paris Exhibition of 1855. Wrote of hydrostatic weighing in *Pharmaceutical Technics*, Brunswick, 1847. See EQM 2578.

Brauer, E, *The Construction of the Balance*, the Incorporated Society of Inspectors of Weights & Measures, 1909, pp 306-307.

6 Griffin, J J, *Chemical Handicrafts,* 1866, pp38-41.

Karl Freidrich Otto Westphal, chemist & physicist (1806-1879).

7 Boaz, M, 1958, *Robert Boyle and 17th Century Chemistry*, CUP, p132. Robert Boyle, in the 17th century, encouraged people to compare water samples in different areas from naturally-occurring sources, a methodology easily extended to oils and alcoholic spirits.

A steelyard could easily be used to compare the density of liquids, by moving the pear along the beam (with its container of liquid moved below it) until the steelyard balanced. The number at which it balanced was recorded. A nice example of such a steelyard exists in the Science Museum collection, acqu. 1927-1454.

8 Jessie Ramsden, FRS, c.1732-1800. His cone-beam balance is on loan to The Science Museum, London.

Ramsden, J, An Account of Experiments to Determine the Specific Gravity of Fluids, Phil Trans, London, 1792.

9 Blagden, C, Report on the Best Method of Proportioning the Excise upon Spirituous Liquors, *Phil Trans*, 1790, vol. 80, p 321-345.

Blagden, C, Supplementary Report on the Best Methods of Proportioning the Excise upon Spirituous Liquors, *Phil Trans,* 1792, vol. 82, pp 425-438.

10 *Phil Trans*, 1675, vol. 10, pp 329-348.

11 Morrison-Low, A D, Hydrometer, *Instruments of Science, An Historical Encyclopaedia*, ed. Budd & Warner, Garland, 1998.

The Guy Lussac hydrometer was divided into 100 parts, with pure alcohol at one extremity, and pure water at the other. This was less arbitrary than those of other makers until the late 19th century.

12. *Philosophical Experiments and Observations of the late Eminent Dr. Robert Hooke, SRS and Geom. Prof. Gresh.* pub Derham, London, 1726.

Reynold's Patent Model

BY TERRY WESNER

In the mid-1990s, I was walking through an antique show in Chelsea, Michigan, and as usual, I was lagging behind my wife, Mary Ann. Unique and unusual things fascinate me, and this always causes me to be the one bringing up the rear. Mary Ann likes to scout ahead, occasionally reporting back to me about something interesting.

At this particular show, she came to get me grinning like the Cheshire Cat. She said that she almost hated to bring me to the booth up ahead, because I would probably want to spend the night in it. She had found the ultimate collectable for me.

As I approached, I saw the banner that read *Early American Inventor's Models -- a rare opportunity to own an original one-of-a-kind inventor's model.* These were the working models that were submitted to the United States Patent Office for the purpose of getting a patent.

I did indeed spend the rest of the night in the United States Patent Model Foundation booth. The show was closed for more than a half hour before my wife could pry me away, but only because it was a two-day show, and we would return the next day.

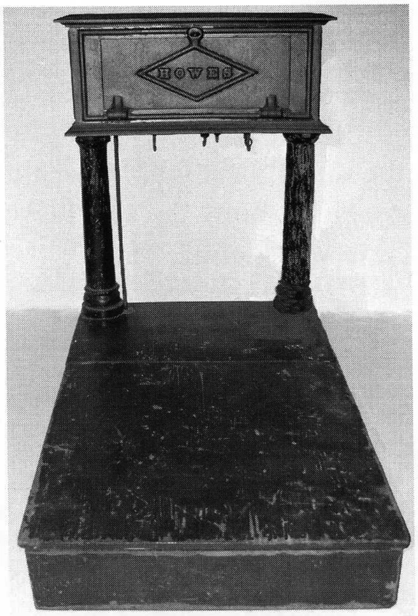
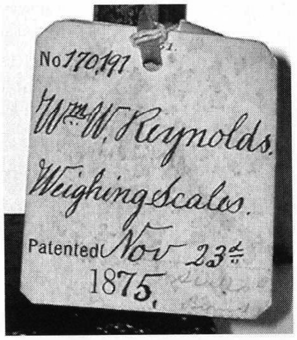


Fig. 1. W W Reynold's patent no. 170,191 modelled in wood and bronze. Only 9^{1}/4ins. high although the full-size scale was designed to charge blast furnaces.

Thus began my odyssey of collecting patent models. I bought 9 models at that show, purchased some clock patent models through the National Association of Watch and Clock Collector's Mart, and then came eBay.



No 170191

Wm W. Reynolds.

Weighing Scales.

Patented Nov 23rd

1875.

Fig. 2. The original label on the scale model.

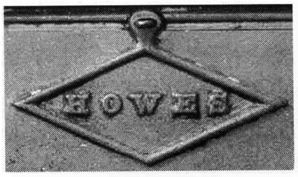


Fig. 3. The trade mark of the maker of the model. Not to be confused with the trade mark of the Howe Scale Co.

I would like to give a brief history of how these models came into being. The Patent Act of April 10, 1790 required that an inventor had to submit a working model of his invention to the Patent Office. The requirements placed upon the models varied as the patent laws changed. The one most commonly associated with patent models is that the model must be no more than twelve inches in length, width, or height.

Patent number 223,211 was issued on Jan 6, 1880. Patent number one was issued was on July 4, 1836. Prior to that there was no number assigned to a patent. Pre-1836 patents are referred to as X patents and there are about 10,000 of them. With the ever-increasing number of models, the Patent Office deemed them impractical, and the law was changed to no longer require submission of a model to be able to obtain a patent. Between 1880 and 1885 many inventors still submitted models of their inventions. I have a model from 1894 and some were submitted into the early 1900s.

In 1836, fire destroyed the building housing the patent models. Congress authorized $100,000 for reconstruction of some of the models and patent

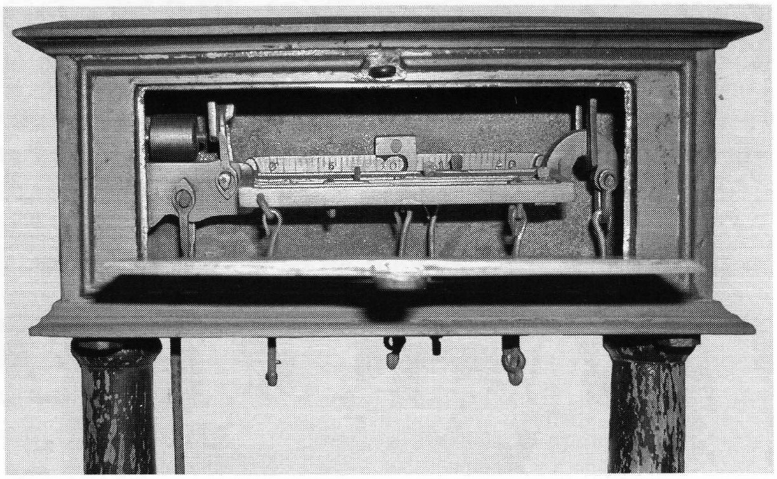


Fig. 4. The interior of the model, showing the metal beams and the swan-neck end on the beam at the back. The hanger on the left should have a large poise hanging from it, but this is missing. The sub-beam nearest to the camera has lost its long hanger, although its stub can just be seen below the beam.

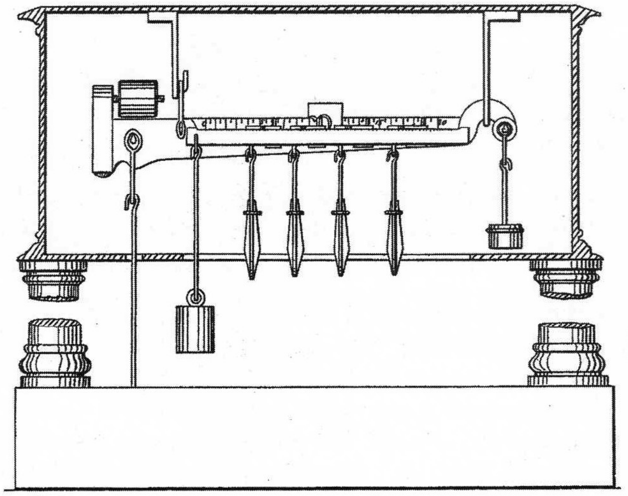
records. By 1876 the public was barred from seeing the models due to lack of space, and in 1877, fire destroyed the north and west model halls. An estimated 76,000 models were lost. Many were rejected models stored in the west model hall.

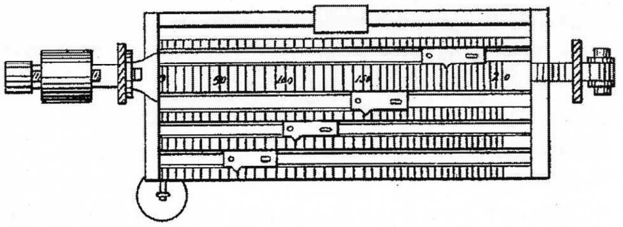
Since inventors were still submitting models after 1880, it is difficult to determine how many models were in the Patent Office Collection. By the early 1890s there were approximately 150,000 models, and in 1893 most of the models were placed in storage.

In 1907, Congress decided to dispose of the models. The Smithsonian acquired 1000 models by famous inventors. The next year, Congress decided to sell the models. About 3000 models that never received a patent were sold at auction for $62.18. The remaining models were stored in a livery stable until 1925 when Congress, no longer wanting to continue paying the cost of storage, appropriated $10,000 and authorized a committee of three to get rid of the models by whatever means necessary. The Smithsonian got those models that were identified as having real historical

Fig. 5a & 5b. Patent 170,191 for a scale for *charging blast, smelting, melting furnaces, to provide a means whereby the exact quantity of either material may be weighed by an attendant too illiterate to accurately read either the scale of the beam or any lettered directions attached to the apparatus, and too careless or obtuse to clearly distinguish from memory alone the different weights required of the various materials*. Each of the four identical pendants has hung from it one of the ingredients (as a sample that the attendant CAN identify) and the slide with its hanging pendant on each of the four beams is fixed by the master in the correct weighing position To use the scale, the attendant moves the big, left-hand poise onto one of the four hangers and loads the platform with the material that is the same as the sample hanging from that hanger. When it balances, he returns the big poise to the left-hand hanger and unloads the platform load into the furnace. Then he moves the big poise onto the next hanger, identifies the sample on that hanger, and loads the platform with that material. And so on, according to the number of bars built onto that beam, as needed by that recipe.

Was this scale made? We do not know. Certainly William Reynolds was associated with the Howe Scale Co of Brandon, VT. His patents 67,349, 67,908, 76,523, 260,415 & 269,113 were assigned to the Howe Scale Co, but not 121,420 & 170.191. His patents 132,321, 173,669 & 174,154 were assigned to the Brandon Mfg Co. See EQM, 2756.





value. The Patent Office kept some models on display, a few were returned to the inventor's families, others given to cities and museums that had an interest in them, and some destroyed.

Herbert Hoover sold the remainder of the models to philanthropist Sir Henry Wellcome. The models were shipped to Tuckahoe, New York where Sir Henry intended to open a museum, but his intentions were never realized. A few of the models were exhibited and a few were sold but most of the models remained in their packing crates. A New York dealer purchased 15,000 models and had pushcart vendors selling them on the streets for 25c each.

In 1936, Sir Henry died and the models were sold to American Patent Models, Inc. Five hundred models were shipped around the country for display in department stores, and about 20,000 models were moved to Rockefeller Plaza, New York for display in a museum. Once again, the intention to open a museum was not realized, and 3,500 cases were stored in New Rochelle, New York.

American Patent Models, Inc., declared bankruptcy in 1940 and the next year the models were put up for auction in Foley Square, N.Y. One bidder represented a group of junk dealers who were weighing the cases to sell the scrap metal to Japan. Prosperous auctioneer, O Rundle Gilbert had the winning bid of $5,000 and the models were moved to his home at Garrison-On-Hudson, N.Y. Gilbert prepared many of the models for an auction, but a fire in 1943 destroyed the barn and an estimated 15,000 models.

Between 1943 and 1979 Gilbert held many auctions selling approximately 10,000 models. In 1979, Cliff Petersen, who started collecting patent models in 1973, decided to purchase the remaining 800 crates, some of which had not been opened since their packing in 1926. The models were classified, evaluated and priced. Petersen distributed fully-illustrated catalogues to individuals, museums and state historical societies. After 8 volumes his Catalogues were discontinued.

In 1989,Cliff Petersen donated approximately 30,000 models to the United States Patent Model Foundation, which reportedly sold them in antique shops, auctions, and flea markets. It was from them that I purchased my first models. The activities of the Foundation were the subject of an ABC 20/20 news exposé and approximately 20,000 models remain in limbo based upon a legal settlement. Petersen had two auctions at Christie's in the mid-1990s, and approximately 4000 models now reside in the Rothschild Petersen Patent Model Museum.

Of the original 150,000 models that were put in storage, about 20,000 are in the Smithsonian or other museums. At least 15,000 were lost to fire, and 20,000 are tied up in a legal settlement. We cannot be certain of the accuracy of these figures, but it seems reasonable to assume that about 90,000 to 100,000 models are in private collections. One last thing that complicates this number is when a model loses its patent tag. Without its tag, it usually cannot be verified that it is a patent model, and not a salesman's sample. The number of models with tags might be closer to 65,000.

Author's Biography

Terry Wesner has approximately 250 patent models, and hosts a website dedicated to information about patent models, at <<www.patentmodelassociation.com>>. The website for The Rothschild Petersen Patent Model Museum, the largest privately-owned collection of United States patent models, is <<www.patentmodel.org>>. This site also has many interesting links. Containing nearly 4,000 patent models and related documents, the collection spans America's Industrial Revolution. Wesner is a biostatistician who changed direction to teach. He wrote a successful series of 20 college mathematics textbooks and now owns Bernard J Klein Publishing. Visit <<www.totallyfreemath.com>> and download an entire textbook hyperlinked to the instructor's resource materials for free.

Beginners' Guide, Part 6

The Beginners' Guide is an attempt to define the ways in which scales operate. It is not intended as a guide to usage. This section deals with hydrostatic scales, but only with reference to liquid being used as the resistant. This sub-group can be defined as 'hydraulic scales' for our purposes, whereas the term 'hydrostatic scales' can be defined as scales that are measuring specific gravity and density using liquid as the medium in which the solids are submerged, or where a solid is submerged in various liquids.

8. Hydraulic Scales

Beam	Various
Resistant	Piston pushing liquid aside. MAIN FEATURE
Fulcrum	Various
Load	Various
Stabilised by	Various
Graduations for equal units	Various, normally up a tube.
Common names	Hydrostatic scale

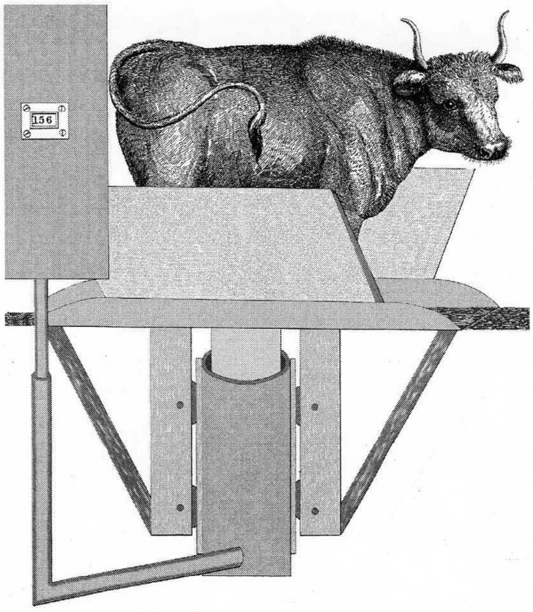
In Burnell's *Rudiments of Hydraulic Engineering,* written in 1858, he states that *hydraulic engineering is principally confined to the operations in which water acts as an incompressible fluid,* so a hydraulic scale is a scale that utilizes the resistance to motion experienced by a piston in a chamber full of liquid. The liquid is normally water, but can be oil, mercury, or other liquid. The liquid is isolated from the scale by being in a cylinder or a bag.

As long as the piston pushes on liquid in a reservoir, the load can be applied to the piston in various ways. The piston may work directly, as in a spring balance, may be hung from an unequal-arm beam with the piston at the other end of the beam as with a steelyard. The load may be above the beam, using roberval linkage to stabilise the load, with the piston at the other end of the beam.

Development of the idea

In the UK, one isolated example was patented in 1786 (Fig. 1a & 1b). Another strange one was invented by George Medhurst (who possibly invented the roberval scale) in 1817, but, after that, nobody seems to have considered hydraulics until 1839, when lots of people started to think about hydraulics.

In the UK, *The Mechanic's Magazine* illustrated several hydraulic scales that their readers had invented. One gains the impression that their discussions were included more as a novelty than for consideration as a serious method of weighing! In February 1839, they published Ericsson's Crane Weigher, and they refered to Hawkins' Domestic Weighing Machine, invented by Robert Wiss in 1825 and discussed friction. In Feb 1840 they



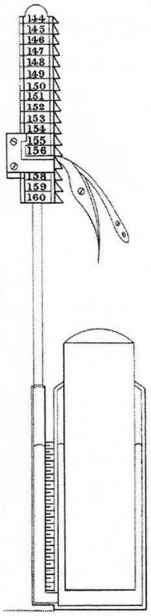
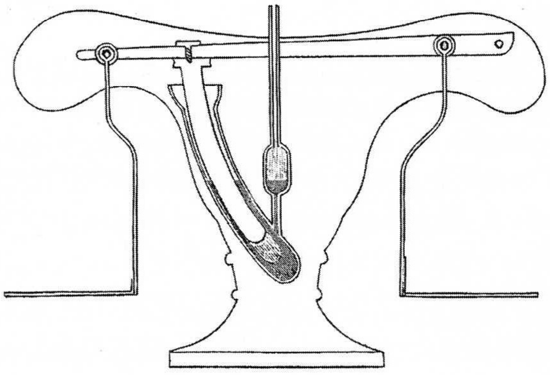


Fig. 1a & 1b. ◁▷ Samuel Miller's patent 1545 of 12 Jun 1786. The cow (at Smithfield Market in London!) was expected to walk onto the platform and wait there while its weight depressed the float below the ground, pushing the mercury (or other fluid) up the tube on the left. The patentee did not explain how the second piston, that had the graduated chart at its top, was raised consistently but he provided a catch whereby the chart was stopped when the number was at its highest in order to read it after the piston had descended. One must suspect that the scale was never built!



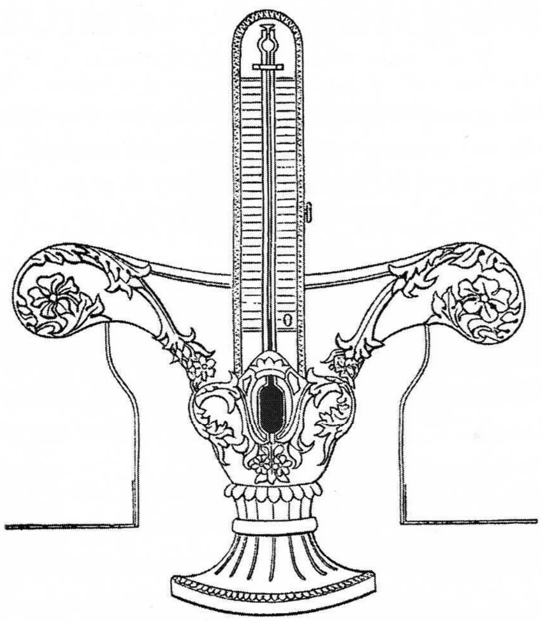
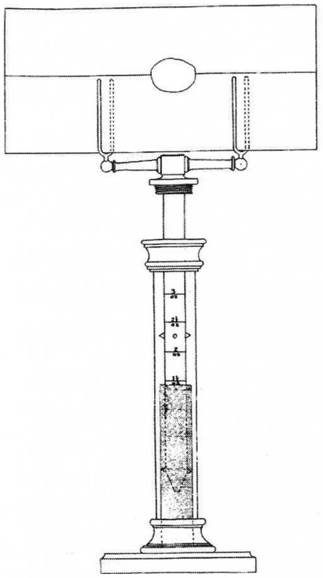


Fig. 2a & 2b. ➢➢ Bursill's patent no 267 of 28 Nov 1840. *Mercury is poured into the holder, which may be made of any suitable material, but well-baked pipe-clay is found to answer best, mercury having less tendency to adhere to that than to any other substance . . . An open-topped glass tube, which may be closed by a cock or stopper, is fitted air-tight into the smaller mercurial holder; into this glass tube some coloured fluid of less specific gravity than mercury (as oil, water, spirit or dilute acid) is poured until it fills the space above the mercury and rises a little way up the glass tube. A moveable index plate, properly graduated, is placed in contact with the glass tube, the zero point of this scale being brought to an exact level with the top of the coloured fluid. On loading, the piston will be pressed down, which, displacing a quantity of the mercury proportional to its bulk, will cause that in the other vessel to rise, and the displaced water or other fluid of less specific gravity resting upon it, to ascend in the tube . . .* The example shown uses the ratio of the steelyard to enable heavy loads (say, pounds and ounces) to be weighed from the short arm, and light loads (say, ounces and drams) to be weighed on the long arm. Bursill included in the patent a candlestick version and also a hanging version with the pan suspended below the mechanism.

published Bursill's Design Registrations of 1840, shown above, and in March 1840 they published Robison's postal candlestick. Then the idea was basically ignored until the 1860s, when again, there was a flurry of enthusiasm, both in the UK, and, for the first time, in the USA.

Seven US patents were taken out over a period of 1800-1876. Over the same period, at least UK 14 patents were taken out plus 5 design registrations, making a total of 19 ideas. This suggests that British inventors were more confident

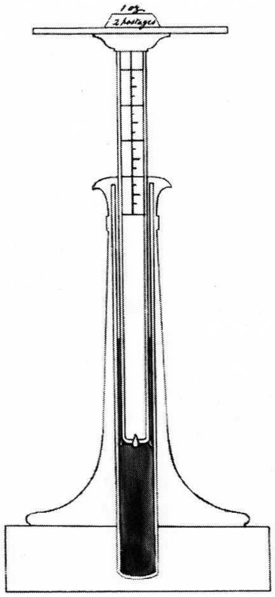


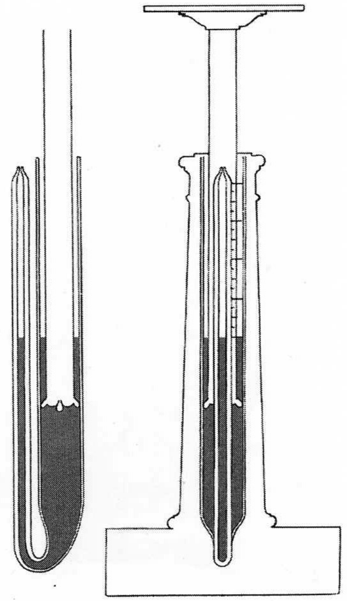
Three examples of postal candlesticks invented in 1839 in the UK. All relied on an ivory piston sliding smoothly down a glass tube without sticking and the first two relied on the mercury slipping up past the piston .

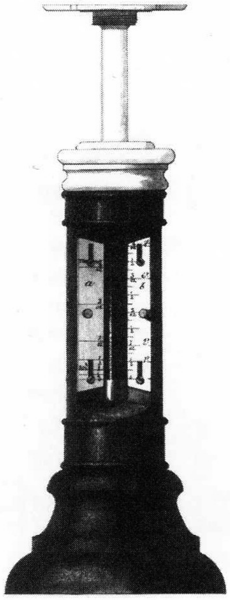
Fig. 3. ⮜⮜ Abraham Follet Osler's design registration no. 125 of 12 Dec 1839. To be featured in a future issue of EQM.

Fig. 4. ➢➢ William Lund's 1st design registration no. 127 of 17 Dec 1839.

Fig. 5. ➢➢ William Lund's 2nd design registration no. 160 of 6 Jan 1840, with a U-shaped tube of mercury.







Bursill designed three interesting postal scales, Fig. 2, 6 and 7. He was right to concentrate on getting the graduated plate in line with the mercury, because mercury evaporates, (to the detriment of the owner's health!!)

Fig. 6. ◀◀ G H Bursill's first design registration no. 267 of 28 Feb, 1840. Glass tube inside wooden tube with adjustable graduated plates

Fig. 7. ▶▶ G H Bursill's second design registration no. 277 of 6 March, 1840. Adjustable pointer. Graduated rod on float.

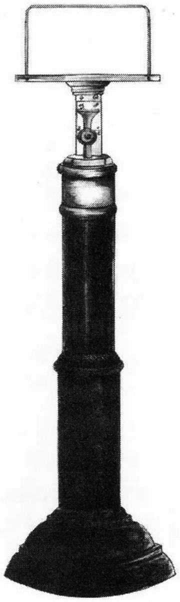
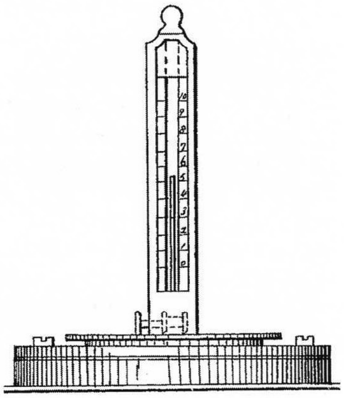


Fig. 8a, 8b & 8c. ▼▼ US patent 26,795 of 10 Jan 1860 by S Squire who invented three hydraulic scales, the first with an adjustable graduated plate to allow for evaporation, the second with levers under the platform for heavy loads, and third with an unequal arm to weigh very small loads. This is the first US patent to mention casually *'an elastic diaphragm'* although it had been suggested by Fontainemoreau of France in his UK patent of November, 1856. Until 1860 the most difficult problem, usually glossed over in descriptions, was sealing the connections, and particularly sealing a bag or diaphragm. Many materials were recommended for sealing, but none seems to have been accepted as particularly effective. Seals included silver foil and animals' bladder.



about the use of hydraulics than were the American. As hydraulic scales are extremely difficult to make effectively, perhaps Americans made working models and realised how ineffective were hydraulic scales, and decided not to bother to patent them!

This is probably the only category of scales for which a relatively complete list can be given, there being so few examples. Industrial users may know of Duckham's crane weigher of 1872 and 1887, and postal scales collectors will know of Osler's 'candlestick' of 1839. Collectors of modern American postal scales will know of

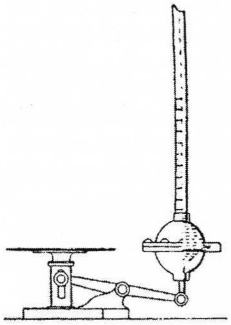


Fig. 9. ▲▲ O'Neill's UK patent no. 2655 of 27 Oct 1863 for a counter roberval sc .

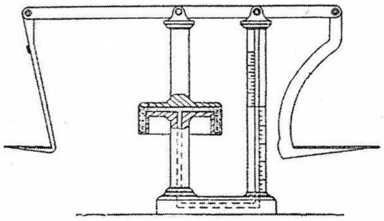


Fig. 10. ▲▲ Rowland's UK patent no. 2818 of 12 Nov 1863. The right-hand tube, with the graduated glass tube, has at its top a second fulcrum. When a heavy load is placed in the right-hand pan, the left-hand pivot raises the bell half way down the right-hand tube.

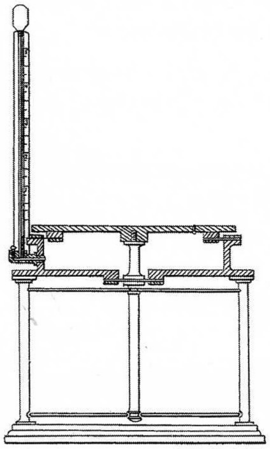
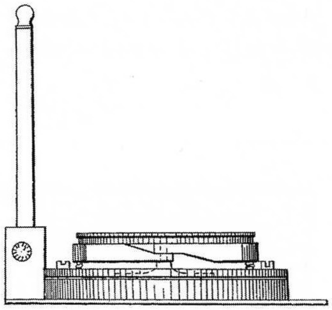


Fig. 11. ▲▲ Baudissin's US patent no. 42,722 of 10 May, 1864. The lower half of the machine contains a box lined with guttapercha cloth, filled with pure alcohol!



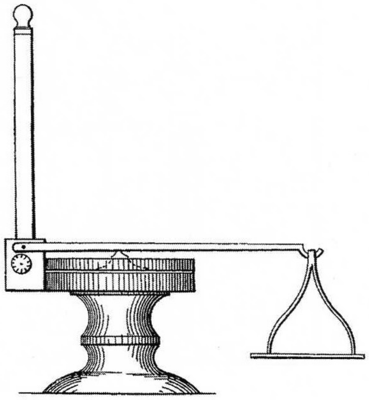
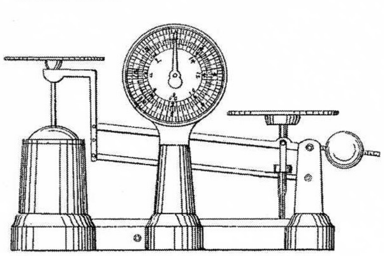


Fig. 12. ▶▶ Clum's US patent no. 46,992 of 28 Mar 1865. The cylinder under the left pan contains mercury, and, for heavy loads an additional spring.



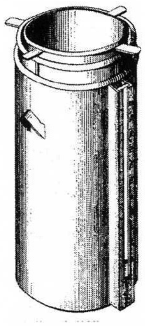


Fig. 13. ≺≺ Hudson's US patent no. 112,043 of 21 Feb, 1871. Back to the simplest version of a hydraulic scale, and back to the problems of friction as the float descends.

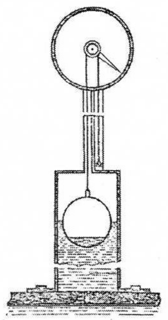
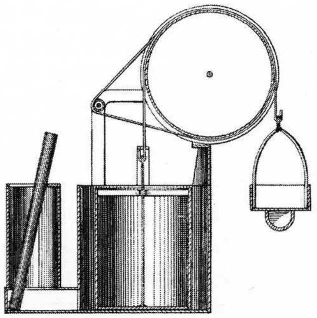


Fig. 14. ≺≺ Roff, Hoffman & Lukey's UK patent no 2408 of 12 Sep 1871, for ascertaining the weight of the load in a ship. The bottom of the cylinder is open to the water under the ship.



Figs. 15a & 15b. ≺≺ Connor's US patent no. 142,991 of 23 Sept, 1873. Very similar in idea to Fig. 14, but intended for counter weighing. To adjust the level of the water in relation to the dial, rods (one of which is already in the left-hand cylinder) are submerged in the water.

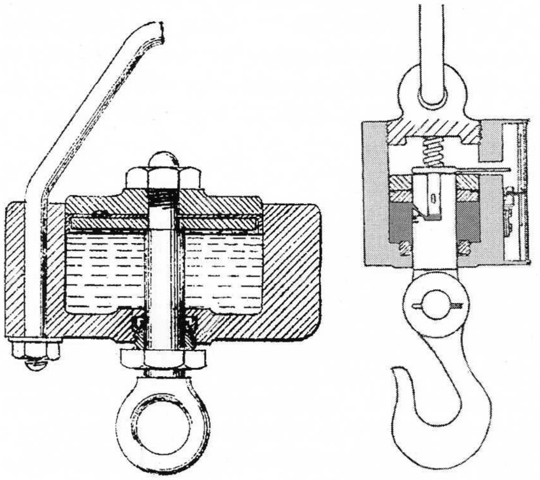


Fig. 16a & 16b. ≺≺ Duckham's US patent 123,621 of Feb 13 1872 and his UK patent no 9351 of 1 July 1887. The cylinder is closed in and the pressure is shown by the compression of a spring. This is acted upon by the rod below it being pushed by the diagonal ram. A Bourdon gauge could be used if desired, instead of the geared indicator. Much used.

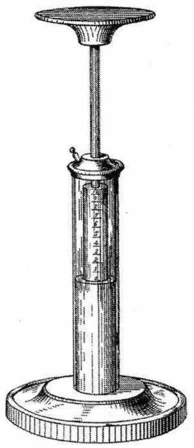


Fig. 17. ≺≺ King's US patent no. 171,670 of 4 Jan, 1876. Re-inventing Osler's idea (Fig. 3) with mercury in a glass tube. This is not for postal use.

Fig.18. ⋎⋎ Hines' UK patent no 3468 of 26 Aug 1880. For a platform scale doing heavy weighing. To secure steadiness of action, the cistern is provided with a perforated plate a little below the top surface of the fluid, having an opening to admit the float, and divided into spaces by the baffle-plates.

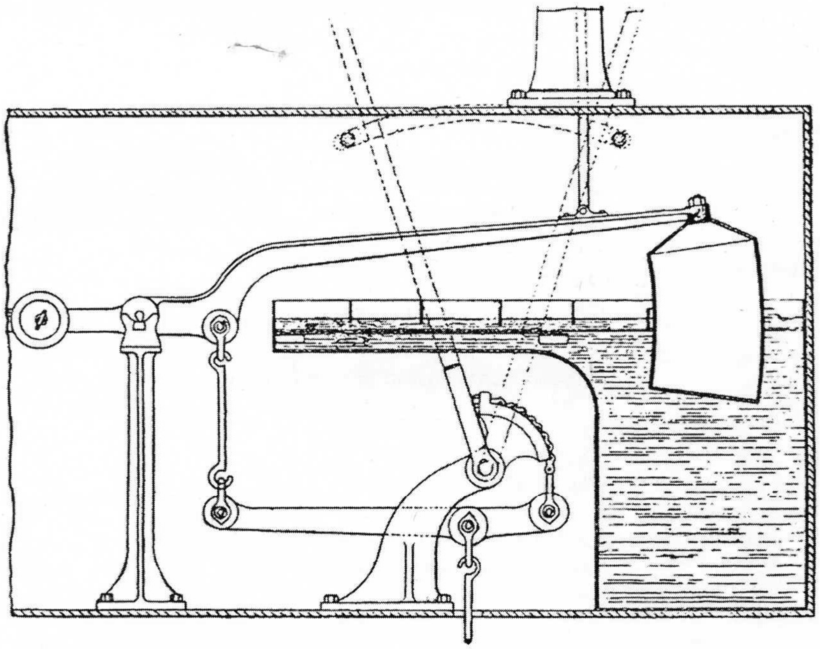
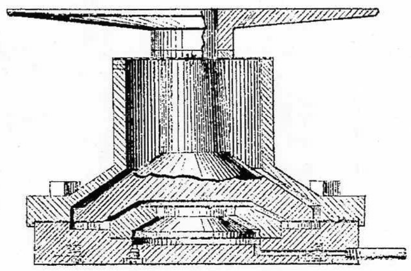


Fig. 19. ⋎⋎ Emery's US patent no. 123,253 of Jan 30 1872. His *hydraulic-pressure support*, this example for his small scales. He designed huge platform scales with hydraulic-pressure supports at each corner, interconnected so that uneven loading did not matter. The pipes from the supports went up the column and were connected to the standard steeyard at the top, so that the lever ratio defined a good part of the weight. Emery went into huge detail over six pages of tiny writing about the design and building of these supports. He was obviously thoroughly experienced in hydraulics, but he may have made it easy to evade his patent because of the precision of his description.



UK Design Registrations giving three years of protection

Date	No.	Registree	Function
12 Dec 1839	125	Osler A F	Glass tube with float on mercury, for letters
17 Dec 1839	127	Lund, W	Ditto
6 Jan 1840	160	Lund, W	Ditto
28 Feb 1840	267	Bursill G H	Glass tube inside wooden tube with adjustable graduated plates
6 Mar 1840	277	Bursill G H	Adjustable pointer. Graduated rod on float.

Eldon's scale, and German collectors will know of the example shown in Fig. 28, but, apart from these four examples, few members will own a hydraulic scale.

UK Patents (incomplete)

Date	No.	Patentee	Function
13 May 1786	1545	Miller S	Platform sc, fluid beneath being pushed up tube with graduations
26 Aug, 1817	4164	Medhurst G	Floating bodies upon water to ascertain their weight
28 May 1840	8522	Bursill G H	Mercury resistant plus coloured water indicator, zinc thermometer
9 Dec 1853	2868	Shanks A	Discs or bags of mercury forcing liquid up a tube
27 Nov 1856	2808	Fontaine-Moreau P A,	Various letter bals with top pan & side tube graduated
27 Jul 1861	1878	Thuau C	Top pan & side tube graduated
14 Nov 1862	3070	Morgan H & Parkinson J	Platform sc with series of graduated glass tubes
29 Apr 1863	1076	Rowland E	Equal-arm beam with extra fulcrum to become steelyard, plunger
30 July 1863	1888	Firth W & Firth S	Crane weigher hydraulic hoist with water guage
27 Oct 1863	2655	O'Neill P B	Counter roberval sc with tube on one side
12 Nov 1863	2818	Rowland E	Similar to above
24 Nov 1863	2953	Schiele C	Crane weigher [protection refused]
24 June 1864	1593	Amsden A	Tube of water rising from bottom of ship, indicating how much the ship sinks under load
12 Sept 1871	2408	Roff, Hoffman & Lukey	Similar to above
3 July 1872	2009	Furness H D	Combined lifting jack & weigher of locomotives & wagons
19 Dec 1876	4907	Bucknill J T	Candlestick-type
? ? 1877	2468	Cozzo A	Platform sc
17 Jan 1878	224	Cozzo A	Relieving mechanism for above
17 Apr 1878	1543	Westinghouse G	Mercury for weighing lg loads
7 Aug 1879	3171	Deschamps J,	Candlestick
26 Aug 1880	3468	Hines J,	Heavy-duty, platform sc
25 Feb 1882	927	Royle J J	Coloured liquid in glass tube
27 Apr 1883	2128	Darling J	Float on one arm of beam for all kinds of w/g m/c
26 May 1883	7758	Bache C R	Screw jack with hydraulic ram to indicate wt of wagon
19 Feb 1884	3596	Wickstead J H	Hydraulic testing m/c with rollers & rams
1 July 1887	9351	Duckham H	Crane weigher
26 May 1888	7758	Bache C R	Portable wagon weigher. Glycerine
11 May 1891	8062	Davis G	Crane weigher
30 Nov 1891	20880	Jackson J & Hoad E A	For weighbridges, damper to prevent damage by shock
19 Mar 1894	5686	Lohnstein T [agent]	Hydrometer used as weighing apparatus
19 April 1894	7768	Allen W D	3 chambers for liquid interconnected
23 Jun 1899	13051	Denison G H	Platform m/c
6 May 1904	10485	Haddan H J	Counter sc.
16 Mar 1927		Murray T S	?
25 Dec 1942		Leech & Henshaw	Plastic boxed postal scale (see Fig. 24)
21 Feb 1956		Di Giorgio, L	?

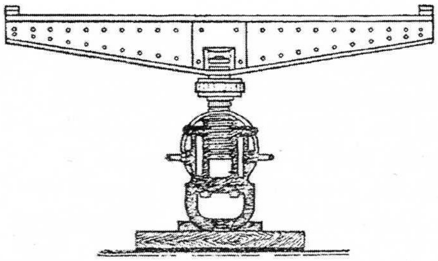


Fig. 20. ➢➢ C R Bache's UK patent no. 7758 of 26 May 1888. For weighing wagons. *A screw jack, the nut of which is in the form of a ram working in a cylinder so that the weight upon it can be indicated by means of a pressure gauge. The screw head carries a beam or cradle which is placed under each axle of the wagon successively. The weight is taken by the nut-ram which rests upon glycerine contained in the cylinder, having a pressure gauge at one side. For convenience of transport the jack is hung on a pair of handles provided with end wheels after the manner of a wheelbarrow.*

American patents (incomplete)

Date	Number	Patentee	Function
10 Jan 1860	26,795	Squire S	Shallow bag in cylinder with large float below platform sc or steelyard
10 May 1864	42,722	Baudissin J O	Roberval pressing on alcohol & water, graduated tube
28 Mar 1865	46,992	Clum H A	Almost a roberval with mercury reservoir & piston under one pan
5 Nov 1867	70,546	Goodes E A	1 quart measuring scoop resting on thumb
21 Feb 1871	112,043	Hudson O D	Floating cylinder has ribbed surface to reduce friction
23 Sep 1873	142,991	Conner W Z	Double reservoir with rods to displace extra water for light or heavy weighing
4 Jan 1876	171,670	Bockhacker F	Container weighing wool, with graduated rod, sunk in water
2 May 1939	2156,325	Witney K E	Wheel scale for motor vehicle, air plane.
8 Dec 1942	2304,363	Johansen, E K	Crane scale

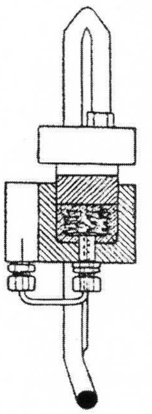


Fig. 21. ≺≺ G Davis' patent no. 8062 of 11 May 1891. *In order to avoid the friction of plunger packing or of glands, the liquid which receives the pressure is contained within a bag of flexible material.*

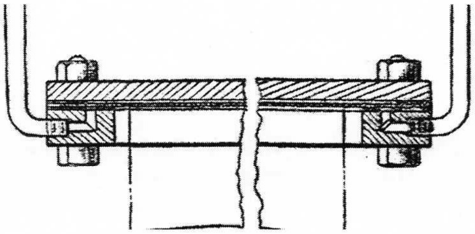


Fig. 22. ➢➢ W D Allen's UK patent no. 7768 of 10 Apr 1894. *A chamber is formed by means of two discs, kept apart by a lead joint ring so as to form a fluid tight joint. The bottom disc is of thin sheet steel and the disc above it of moderately thick steel plates. When the load is applied to the upper disc, as it rests on a firm support, the chamber is deformed and the liquid contained therein is forced out by the outlet into a pressure gauge graduated to give the weight upon the chamber. The pipe on the left is connected to a pump for making good any loss of liquid.*

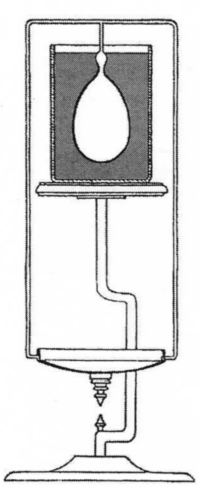


Fig. 23. ≺≺ Lohnstein's UK patent no. 5686 of 19 Mar, 1894. Weights are put into the hanging pan before the load is also added to the pan. This submerges the hydrometer too far below its marked correct position, so weights are removed until the hydrometer is back to its correct position. The sum of the weights removed is then added up.

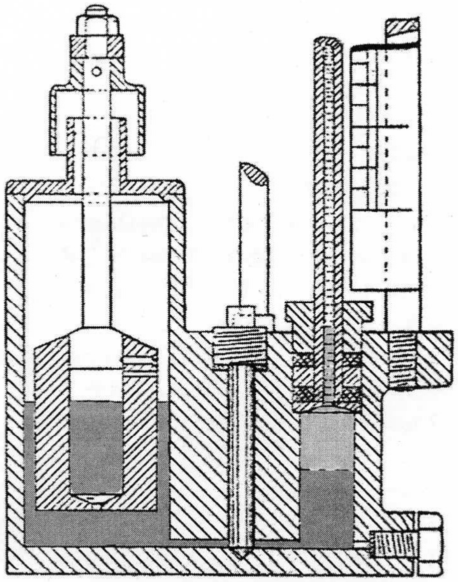


Fig. 24. ➢➢ Denison's UK patent no. 13,051 of 23 June, 1899, This is modification of a patent of 1896 for a hydraulic machine that has a bath of mercury, with a plunger suspended from the end of a steelyard. Denisons must have been manufacturing this machine, as, otherwise, why would they patent an improvement? The vertical rod on the left is suspended from the steelyard. Coloured water floats above the mercury and goes up the glass tube. The graduated plate on the right can be adjusted in height to allow for evaporation.

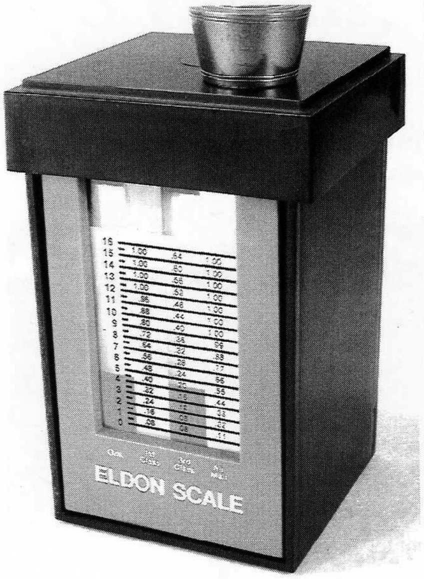


Fig. 25. ◄◄ The Eldon Scale is a postal hydraulic scale patented on 25 Dec, 1942. The whole scale depends on the waterproof sealing of the perspex box. The front face is brown perspex with a clear window graduated in ounces, 1st Class, 3rd Class and Air Mail. The graduations are on a thin sheet of plastic slipped between the brown and the clear perspex, so that it can be pushed up or down to zero the coloured water. The back of the clear window has a lime-green stripe behind the 1st Class graduations, and a silver stripe behind the Air Mail ones. Underneath it states : *Yearly Accuracy Check Depending upon certain climatic conditions your Eldon Scale could lose a small amount of fluid due to evaporation. This could prevent the scale from weighing accuarately at levels over 14ozs.*

Check your scale yearly by sliding the scale face label to its lowest possible position. If the liquid level is between 1^{1}/2 and 2ozs your scale is weighing accurately at all levels. If the fluid level is below 1^{1}/2ozs add a small amount of tap water through the rear plug hole bringing the liquid level between 1^{1}/2 and 2ozs. Replace plug, adjust the scale label to the zero level and your scale is accurate at all weights.

This emphasises the problem of evaporation, common to all hydraulic scales open to equalise air pressure. Only the units containing a bag of liquid had overcome this problem. This scale has such a tiny hole that a hyperdermic needle has to be used to correct the water level!

Note that the nesting weights are only to depress the letter plate by 4^{1}/2oz.

German Patents (started in 1878) collated by J Schlender

Date	No.	Patentee	Function
10 Apr 1878	5931	Kleeman F	Scale with linkage (such as roberval?) and float in water
28 Jan 1879	6515	Wackermann C	2 cylinders interconnected, and with weights to be added
19 Sep 1878	6561	Cozzo A	Platform scale to weigh trucks with a pressure gauge
2 Jul 1879	8544	Rowan W R	Car-jack type scale for railroads
15 Feb 1887	41021	Zabel C	Fluid in a flexible bag. Advantage of extremely low platform.
28 Sep 1890	56372	Wolff O	Fluid in a ring that holds sack open for filling, & indicates wt
3 Mar 1897	97465	Hecht P	Railroad sc. Several cylinders plus 1 cylinder taking weights.
15 Mar 1902	139525	Jeske M J	Simple inner cylinder with outer graduated cylinder
28 Sep 1919	335786	Fritz F jun	Similar.
2 Sep 1921	390102	Hardel J A	Cylinders under platform. System to keep verticality.
3 July 1986	DE 3206959 C2	Haag G	Similar to Jeske's but with vertical guides

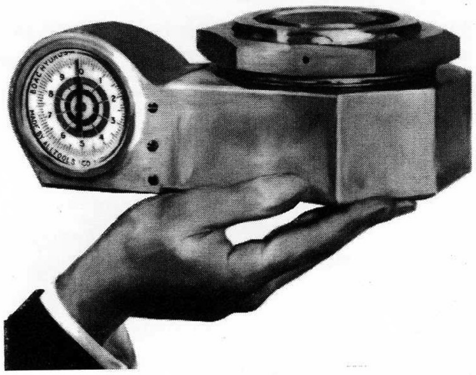
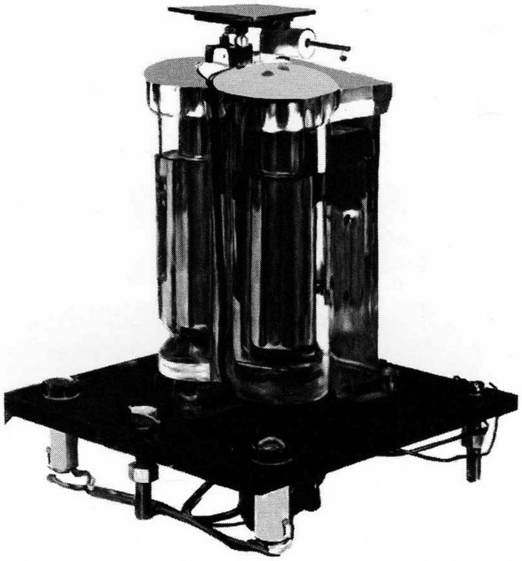


Fig. 26. ▲▲ ISASC members collect small scales, but this one might be an exception! Although it is so small, it is for weighing aircraft up to 25 tons capacity per wheel! It was commissioned by BOAC in 1952, as their hydrostatic Weighing Unit, made for them by Alltools Ltd, of Great West Road, Brentford, UK.

Fig. 27. ►► A hydraulic displacement weighing unit. For check weighers the load is automatically fed onto the platform. When the float mechanism is depressed by ^{3}/32ins, an electrical contact is made on the mercury switch which denotes that the load is at least the required minimum weight. Underweight loads are rejected by a solenoid operated arm. Overweight, a depression of the float by ^{5}/32ins diverts the load onto a separate conveyor belt.



UK Board of Trade Notices (incomplete)

Date	No.	Applicant	Function
Apr 1907	50	East Ferry Road Eng Works Co Ltd	Crane weigher, a crib of Duckham's patent
Dec 1910	104	?	Similar to Amsden's UK patent of 1864
Jul 1925	272	Bernard Holland & Co	Crane hook

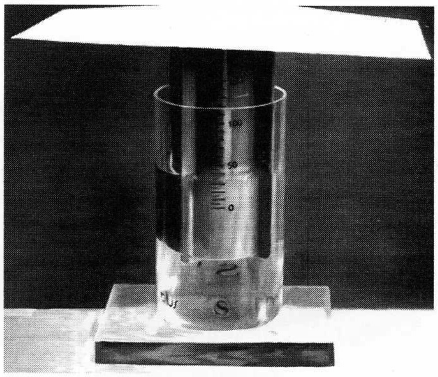


Fig. 28. ➤➤ A German hydraulic postal scale made in 1991. The scale is 14cms ($5^{3}/4$ins) high, its capacity is 150g, and the inner cylinder is blue plexiglass. The inner cylinder has an open top, and can be used as a container in which to weigh powders or liquids. This one was presented to Horst Winskowsky.

Courtesy Mass & Gewicht

Crane weighers came in three varieties, compact compound steelyards, hydraulic scales and, by the 1930s, electric strain gauges. What advantages did the hydraulic scale give?

To sum up, hydraulic scales have been re-invented numerous times, but the only examples that have survived have been either small and simple, for weighing letters, or large and robust for weighing the load on cranes or for weighing wheeled vehicles and their loads.

Editor:
This Guide does not include dampers, in which a piston in a cylinder of liquid slows the oscillations of the mechanism, but is not the resistant, nor does the Guide cover hydrostatic indicators, where the resistant is some principle other than hydraulic.

9. Magnetic Scales

Beam	None
Resistant	Magnets with opposed poles. MAIN FEATURE
Load	Below the magnets
Stabilised by	Suspension
Graduations for equal units	Down a tube, decreasing in size as the load increases.

Magnetic scales are so insignificant in scale history that they scarcely deserve a place. Only one is known to the author. The load is attached to a rod that passes through a hole in the lower magnet, and is attached to the upper magnet. Because the poles are opposed the magnets are continuously 'trying' to escape from each other. Only the tube prevents their escape.

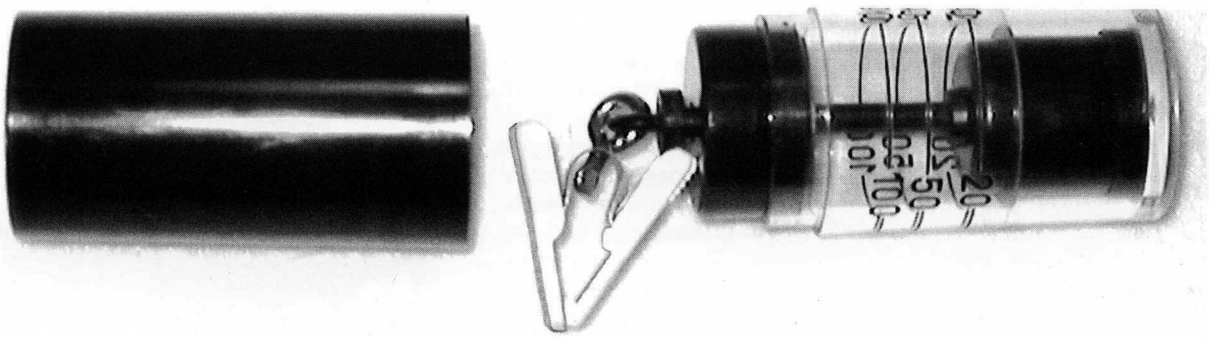


Fig. 1. ⮝⮝ Magnetic postal scale made in Germany c.1976. The weight of the letter pulls the upper magnet towards the lower. Shown lying on its side with the top seen on the right and the cap on the left..

US Patents, 1873-1877

Text by R Hendricks Willard

Captions by D Crawforth-Hitchins

From the very beginning of the nation, Americans have been fascinated with, and proud of, the many labor-saving devices patented by people from all walks of life. But the average citizen had no opportunity to see a new invention until and unless it made its appearance in his locale. The original Patent Act of 1790 required applicants to submit drawings and a working model along with specifications and claims. But only two manuscript copies of each patent were produced, one for the official record and one for the patentee, and the models were never put on display until after 1810, when the Patent Office moved from the State Department to Blodgett's Hotel. Visiting the Model Rooms, which were then called the Museum of the Arts, quickly became a popular pastimefor the general public. Aspiring patentees spent hours and days

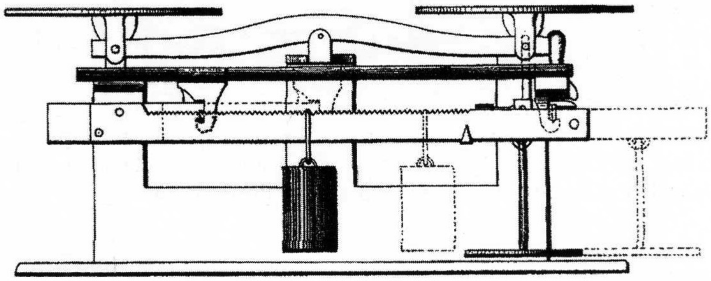


Fig. 1. ▲▲ A M Maynard's patent no. 144,914 of Nov 25, 1873. This counter roberval can be used as an ordinary balance, as long as the front bar is firmly pushed to the left. If pricing is required, the bar is positioned so that the pointer (curled below the bar) points to the price per pound, then the load is added to the top pan on the left, and the hanging poise moved until the balance is in equilibrium. The hanging poise is then in the notch that indicates the price. If the load is above that of the bar, counterpoises (each equalling the total weight of the bar) can be added to the hanging pan below the bar on the right. The price will be the total price indicated on the bar times the number of counterpoises, plus the indicated price on the bar.

Fig. 2a & 2b. ▼▼ W R Parr's patent no. 146,944 of Jan 27, 1874. This mill scale or platform pendulum scale is for weighing grain. The outer ring indicates pounds, the next ring bushels of wheat and clover-seed at 60lb, the next ring bushels of corn and rye at 56lb, the next barley of 48lb, and the next oats of 32lb per bushel, The inner ring is not graduated but can be used to indicate in tons. This fast-readout must have been very useful in 1874.

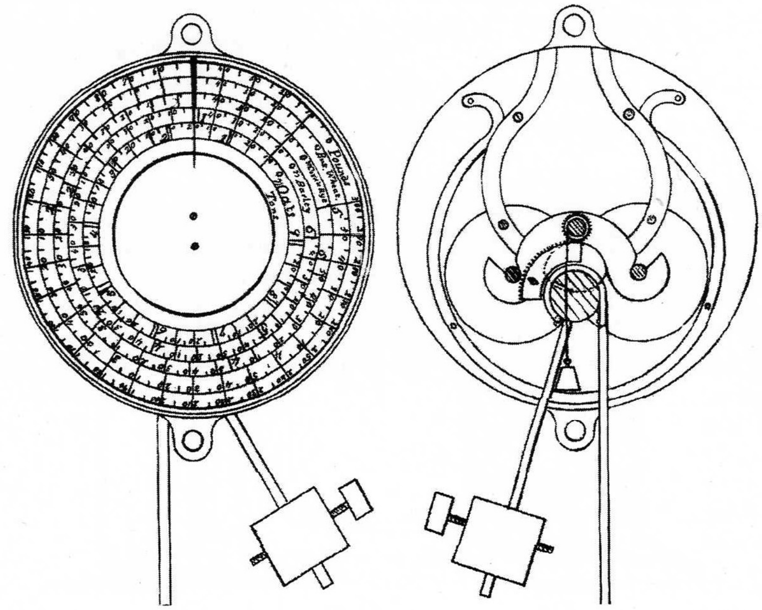
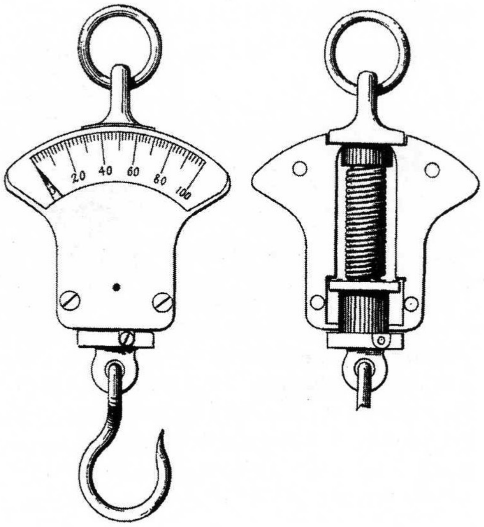


Fig. 3a & 3b. ▼▼ A Turnbull's patent no. 152,195 of June 16, 1874. This cheaply-made spring balance must have increased the sales of Landers, Frary & Clark, the makers. The economy comes from casting the case with a recess to receive and support the mechanism, (the head, hanger and spring having been finished complete before inserting into the case).



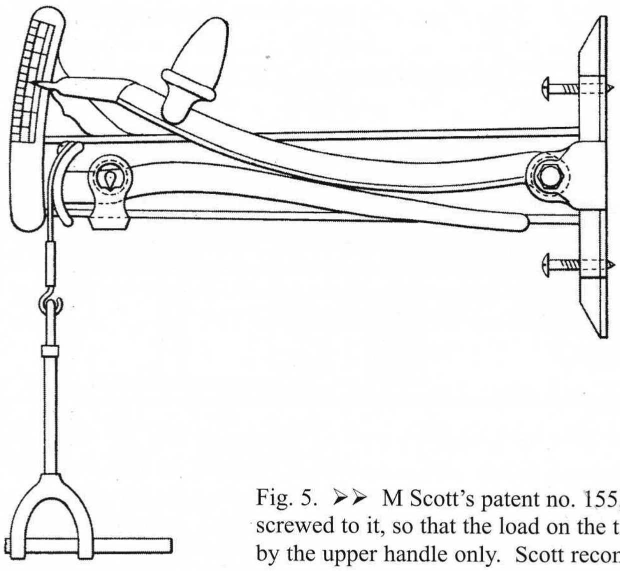


Fig. 4. ≺≺ H F Shaw & G F Shaw's patent no. 153,460 of July 28, 1874. The wording of this patent implies that there were previously-made scales with two curved levers, the upper one pressing down on the lower one. Because the upper one is pivoted at the right, and the lower at the left, both are depressed when a load is applied. The curves are designed so that, at all loads, the point at which the levers touch is in a horizontal line. This means that the graduated arc is always correctly positioned to indicate weight. The inventors are obviously mathematicians, highly versed in the theory of geometry, but, never having seen an example, it is difficult to access the scale's efficacy.

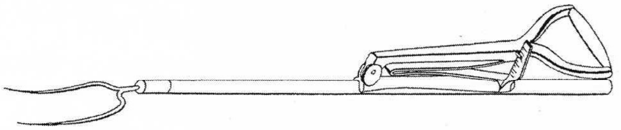


Fig. 5. ≻≻ M Scott's patent no. 155,391 of Sept 29, 1874. The pitchfork has a flexure spring balance screwed to it, so that the load on the tines compresses the U-shaped spring when the whole fork is held by the upper handle only. Scott recommends its use as a weighing shovel, a heavy load for one hand!

examining the patent models to get ideas for their own inventions.

The administration of the Patent Office in the early 1800s appears to have been both high-handed and somewhat haphazard. Despite the Attorney General's decision in 1809 that copies of issued patents should be available upon request, it took the Franklin Institute two years and two requests (1824 and 1826) to Secretary of State John Quincy Adams to obtain informal copies of patents

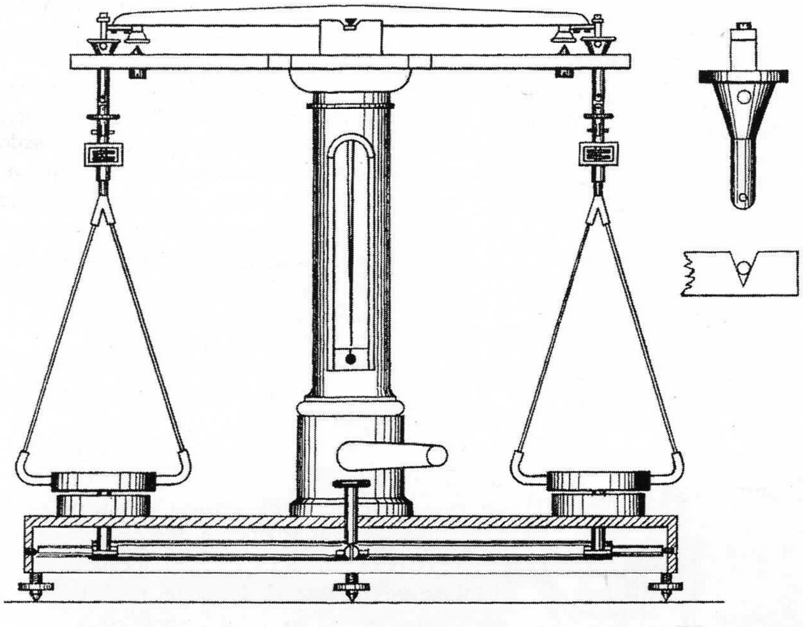


Fig. 6. ≺≺ W Schmolz' patent no. 156,259 of Oct 27, 1874. This bullion scale has 'novel' conical guides to place and keep the bearings of the stirrups in a constant position on the outside knife-edges of a beam. His claim of novelty suggests his lack of knowledge of Marr's UK design registration of 1842 and L Oertling's Staples balance of 1851, both of which had cone guides., but this is scarcely surprising, given the relative isolation of San Francisco at this time. Schmoltz also patented a fine perpendicular adjustment for raising and lowering the stirrups to regulate accurately their lengths by means of two clamp-nuts.

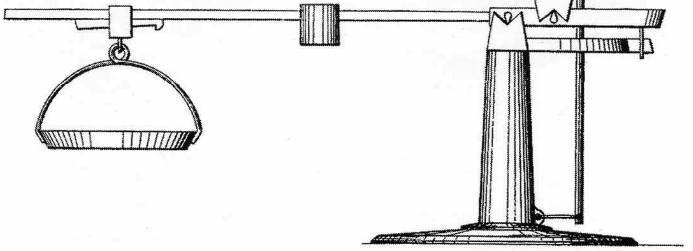
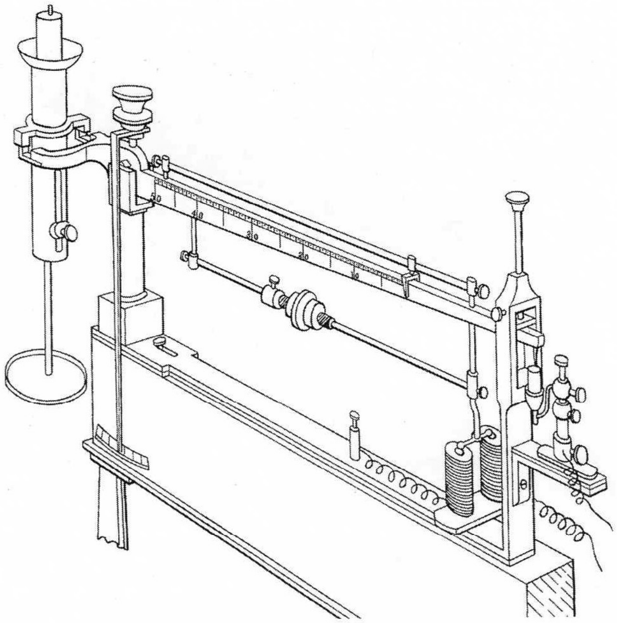


Fig. 7. ≻≻ A A Skinner's patent no. 157,233 of Nov 24, 1874. Another steelyard with a secondary pan, utilising the ratio provided by a steelyard. The hanging pan is positioned on the beam at the mark indicating the ratio of salt desired. Then the butter bowl is placed on the top pan, and brought to equilibrium by the sliding poise. The butter is placed in the pan and salt poured into the hanging pan until balance is achieved.



Fig, 8. ▲▲ W W Goodwin's patent no. 158,636 of Jan 12, 1875. Candle balances were a small part of the market for very precise balances, needed to test the amount of illumination given by either candle, oil or gas. They were used in laboratories and called photometers. Goodwin needed more readily adjustable and accurate balances to determine the number of grains of the sperm of a candle consumed in a given time. When the candle has been lightened by the determined amount (say, 20 grains) the beam tips and the circuit is completed. This operates a subsidiary mechanism (not illustrated) that puffs air at the candle, putting out the flame. The time taken is recorded and the illumination calculated.

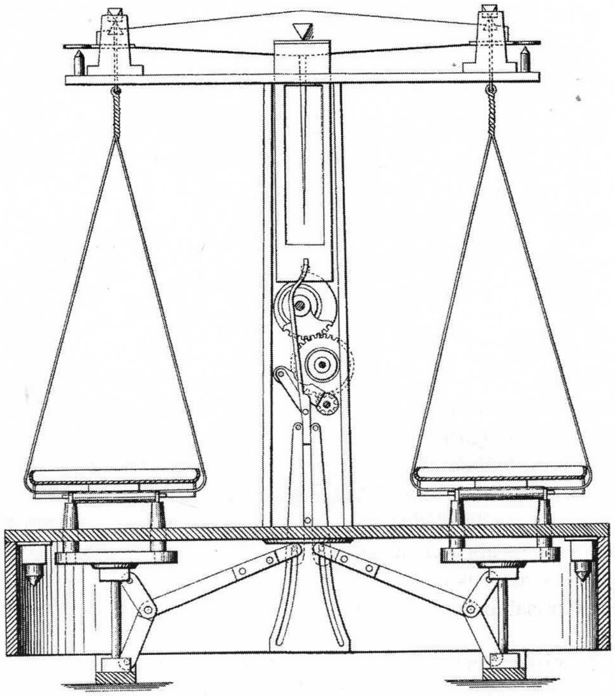


Fig. 9. ▲▲ H S Cochran's patent no. 161,098 of March 23, 1875. This elaborate bullion scale is difficult to understand. Apparently the weighing pans connect to two separate scales, the one scale serving as a test scale for the other. The lower scale, a modified roberval, I think, is used first, then the movable post is elevated and the upper scale comes into play while the lower scale is locked. All this complication does not explain the need for such a cross-checking system. The accuracy of a roberval scale in no way is comparible with that of an equal-arm scale, so why compare the results?

for publication in its journal. There, for the first time, information on recently-issued patents was available for the price of a subscription anywhere in the country.

In 1846, Alfred Beach and Orson Munn bought *The Scientific American*, a small weekly journal that gave patent advice. Obtaining hand-copied records from the Patent Office, they began

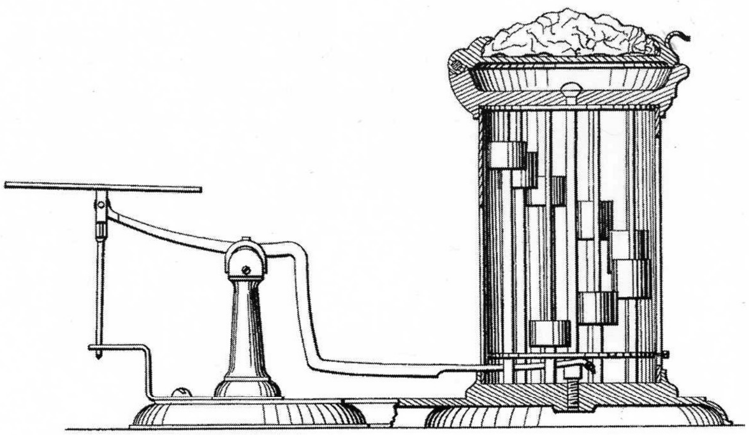


Fig. 10. ◄◄ T Lanston's patent no. 161,130 of March 23, 1875. This letter scale ia a delightful variation on the poise-lifting principle. The steelyard picks up poises until equilibrium is attained, then the pointer (sticking out of the cylindrical casing on the right) indictes the postage due on the graduated plate screwed to the exterior of the casing. Anyone who owns a poise-lifting scale will know that friction is a problem, and this design seems likely to have this problem in an extreme way. Each poise is a cylinder with a hole in its centre. The steelyard pushes the cylinders up their individual rods. If the poises are too loose on their rods they will tip and bind on the other poises near them, and, if too tight, they will bind on the rods.

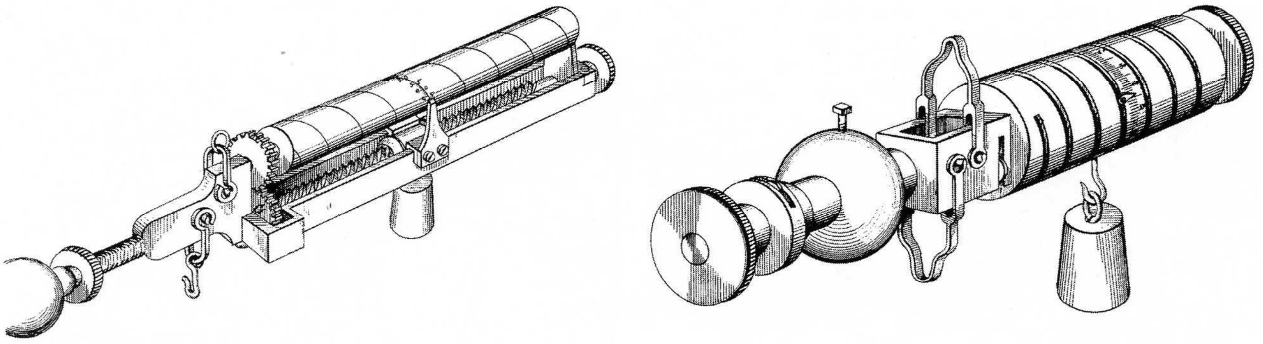


Fig. 11 & 12. ▲▲ T Tebow's patents nos. 161,575 of March 30, 1875 and 161,576 of the same date. This first invention will *admit of a great range without change of weights, to avoid the necessity of the operator having to examine the indications on the detachable weights in addition to the indications on the beam, which leads to confusion and mistake. The sliding poise is adjusted by a screw and carries a pointer, while the revolving drum is actuated by the screw-shaft, and has on it the graduated divisions.* The second patent, although issued on the same day, was submitted six weeks later than the first, by which time Tebow had second thoughts! He decided to enclose the micrometer screw within a drum with a spiral slot cut in it.
Micrometers are a great way of moving the poise, because even the tiniest movement is clearly indicated, the divisions being so well-spaced. His irritation with loose poises reflects the attitude of Weights and Measures Inspectors in many countries, where proportional loose poises were seen as a frequent source of mistakes or frauds.

publishing a weekly list of all patents issued, with the claims annexed. Never before had information about all patents been available to the public so quickly. Soon they were besieged by inventors having questions about patents, so they set up the *Scientific American Patent Agency* to secure patents for their subscribers. In 1868, upon learning that the Patent Office had begun

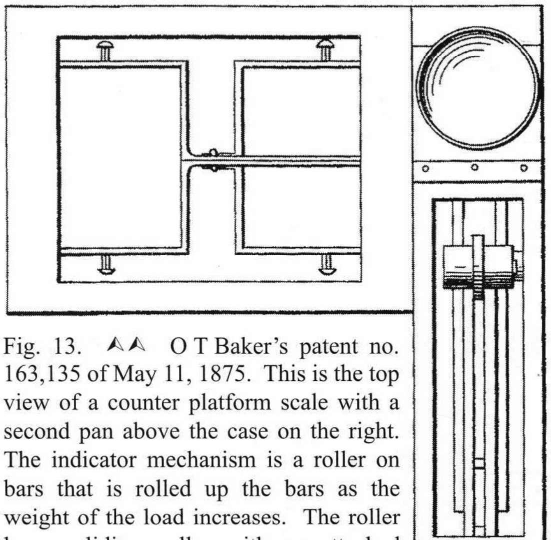
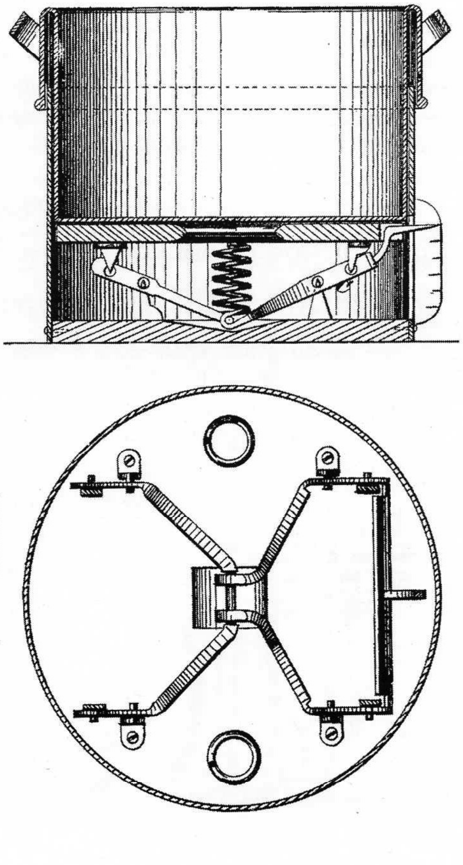


Fig. 13. ▲▲ O T Baker's patent no. 163,135 of May 11, 1875. This is the top view of a counter platform scale with a second pan above the case on the right. The indicator mechanism is a roller on bars that is rolled up the bars as the weight of the load increases. The roller has a sliding collar with an attached pendulous pointer that slides towards the bottom (of the picture) as the load increases.

Fig. 15a & 15b. ➤➤ A Harper & L W Cross' patent no. 171,016 of Dec 14, 1875. The spring balance is used to check the weight of a known measure of goods. Grain is not specifically mentioned, but it would make a useful grain scale. A rim prevents bits getting down into the mechanism.



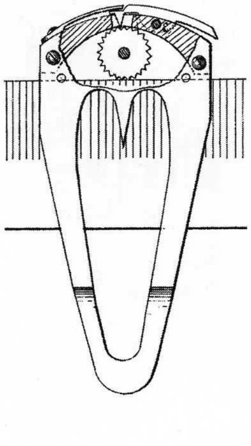
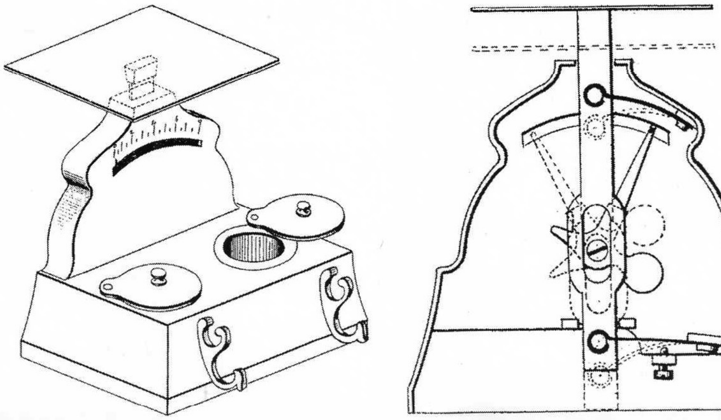


Fig. 14. ➤➤ W T Robinson's patent no. 164,938 of June 29, 1875. One of many attempts to reduce the wear by the poise as it slides along a steelyard, and to provide a locking mechanism to prevent the inadvertent movement of the poise.

issuing printed copies of the claims each week, they requested free copies such as were sent to foreign patent offices. That request was denied. There were apparently some hotly contested negotiations as to a fair price, and the outcome is unknown. But their business grew exponentially and they became preeminent in the field, establishing offices and



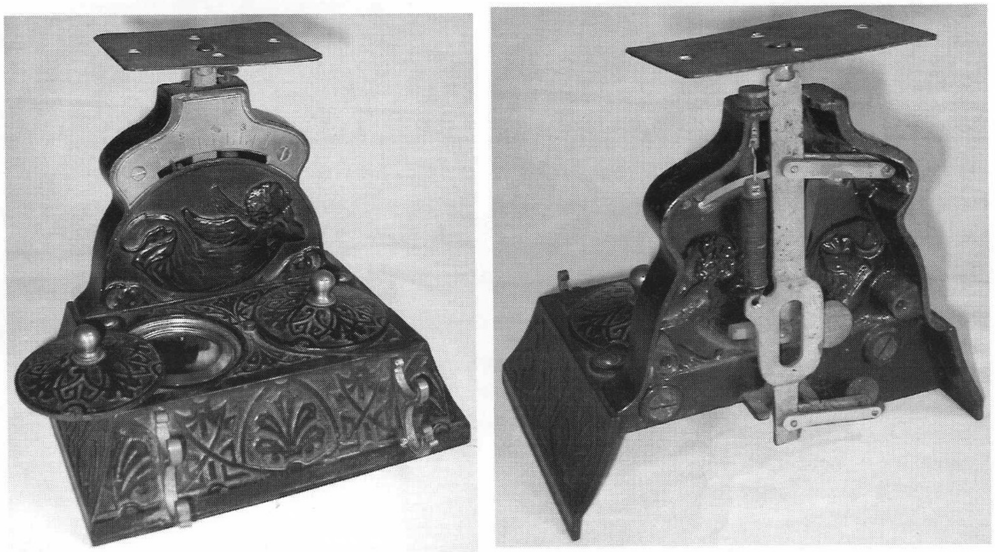


Fig. 16a, 16b, 16c & 16d. ➢➢ A Turnbull's much-collected patent no. 166,569 of Aug 10, 1875. The shape suggests a pendulum scale or double spring balance, but the original idea is not that. The vertical rod below the letter plate is held by two flexure springs, fastened after the manner of a half roberval scale. However, the manufactured version has a normal half-roberval linkage with a single helical spring! How conventional!

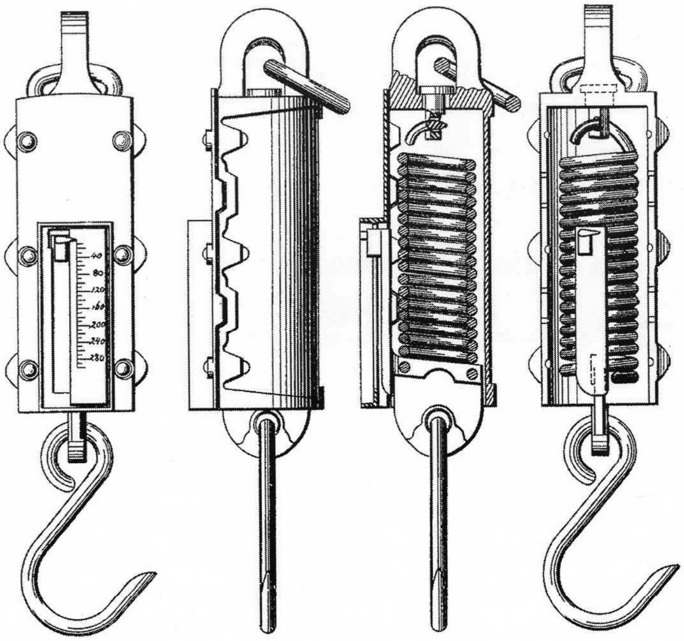
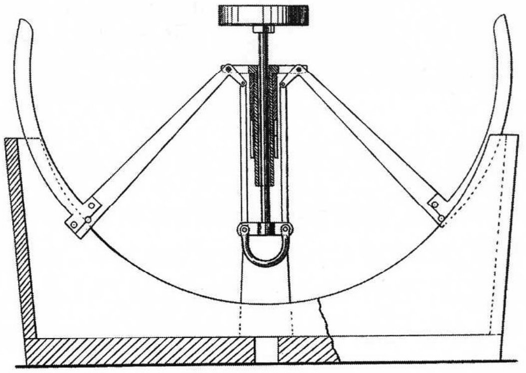


Fig. 17a, 17b, 17c & 17d. ⮜⮜ J P Chatillon's patent no. 171,650 of Jan 4, 1876. To reduce the length of the scale ,he attaches the lower end of the plate (to which the pointer is attached) to the bottom of the spring. At this time, this was a novel way of positioning the pointer.

Fig. 18. ⮟⮟ A Carpenter's patent no. 178,358 of June 6, 1876. A double pendulum scale to weigh, or to determine the steam-pressure in a steam boiler.



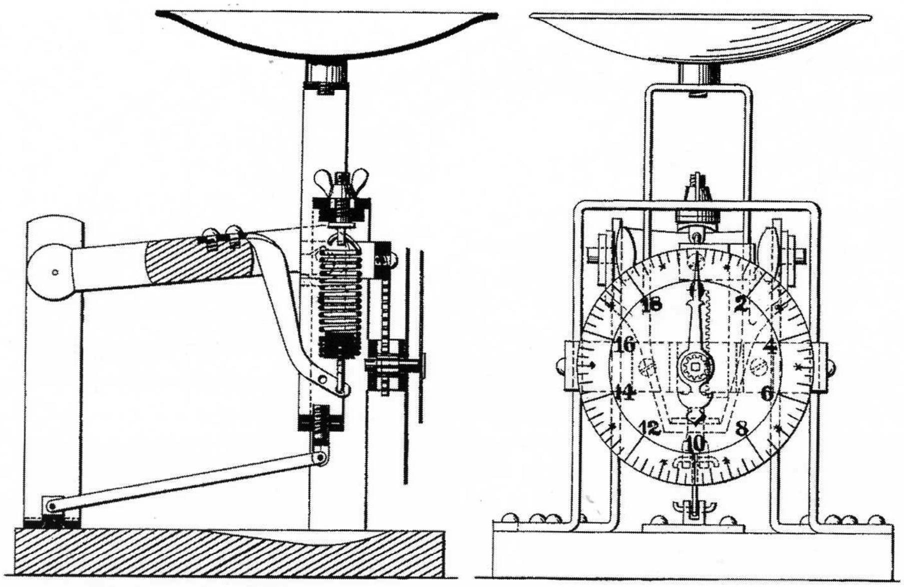
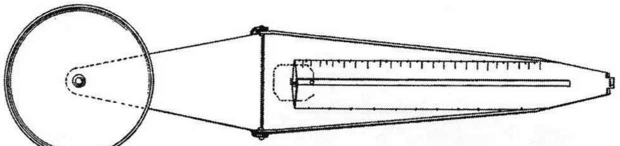


Fig. 19a & 19b. ◄◄ G H Chatillon's patent no. 171,993 of Jan 11, 1876. George had as good an understanding of what makes a good commercial proposition as his father, John, had. The half-roberval linkage stretches the spring as the linkage depresses, separately from the descent of the rod below the pan. This prevents wobble of the rod when the pan is loaded eccentrically, from affecting the vertical movement of the spring. Altogether, a robust spring balance that would reassure users who distrusted spring balances.
Compare it with Gilfillan's patent of 1896. One wonders how Gilfillan got his patent, the similarities are so great! Yet it was the Gilfillan version that stimulated so many bow-front scales.



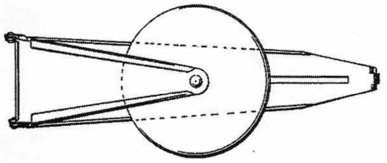


Fig. 20a & 20b. ▲► R H C Rhea's patent no. 178,673 of June 13, 1876. This pocket folding physician's scale can be made in larger versions for domestic or business purposes. The poise is trapped in the slot. At the end of the beam are turned-up prongs to take additional poises.

Fig. 21. ▼▼ P Deland's patent no. 179,842 of July 18, 1876. Called a bucket in one place and then a milk pail. The two spring balances attached to the ends of the handle are reasonably practical, as long as no milk seeps down into the springs. The graduated plate is on the right of the bucket as shown, but the farmer must hold the bucket above eye level and turn the plate towards him, if he is to read it fairly accurately. Not easy.

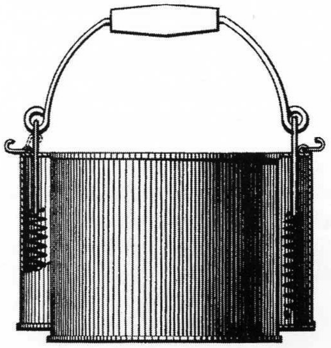
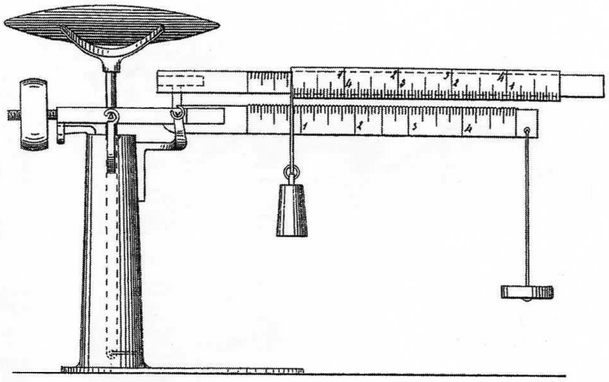


Fig. 22. ►► G R Grove's patent no. 183,156 of Oct 10, 1876. Another counter steelyard designed to indicate net weight and gross weight separately or alternatively, to divide weights as in stock-scales. To tare, the vessel is placed on the pan, and the hanging poise moved to balance it. The top bar is moved away from the fulcrum until it lines up with the hanging poise. The butter is added and the hanging poise moved to balance.



liaisons with other offices all over the world.

Meanwhile, the Patent Office was still struggling to bring its systems up to date. In 1866, they had begun printing ten copies of the specifications for each newly issued patent. In his Annual Report for 1871, then-Commissioner M D Levett noted the necessity for lithographing the drawings of previously-issued patents to allow for proper management practices. The next Commissioner, J M Thatcher, reported in 1874 that, while the Office had spent a lot of money lithographing drawings

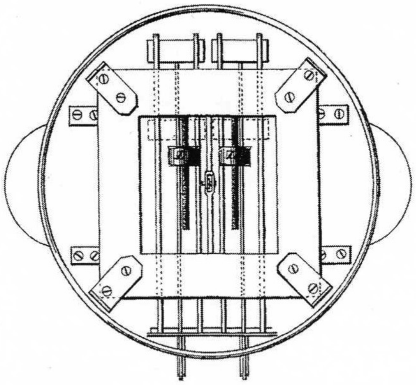
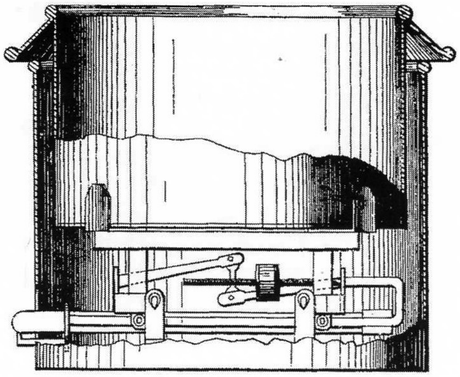


Fig. 23a & 23b. <> L W Cross' patent no. 185,731 of Dec 26, 1876. The compound levers under the measure are connected to two or more sliding bars that pull out of the case until they have drawn the poises far enough to balance either the container or the load, one bar perhaps graduated in pounds and one in ounces, depending upon the design utilised. Grain is an appropriate load, first filling the bucket, then being weighed to ascertain the quality. Compare this design with his previous patent shown in Fig. 15.



of earlier patents, there were still drawings waiting to be lithographed and funds to do it. Within a year, work had at least begun on reproducing the drawings of three-fourths of the old patents. Because the specifications had been printed only since 1866, heproposed to print all the available specifications since 1836 and earnestly recommended an appropriation to begin the work.

In 1875, there were still 60,000 old patents whose specifications had not yet been printed. The office was so crowded that each of the 24 rooms (each 20 by 20 feet) assigned to the principal examiners was occupied by between five and twelve persons. The office was so short of clerical help that it was unable to furnish certified copies of documents within several weeks of a request, even when they were needed immediately in pending lawsuits. In urgent cases, lawyers were allowed to send their own clerks into the office to make copies, while the Patent office charged the same amount that it would have charged if their own clerks had done the work.

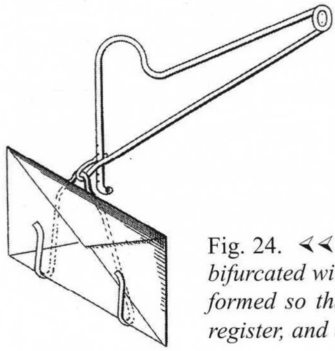


Fig. 24. << J V H Nott's patent no. 186,267 of Jan 16, 1877. *It consists in the combination with a hooked bifurcated wire having a central engaging bend to guard against lateral displacement, of a single spring-wire formed so that one of its extremities acts as a supporting and indicating arm, while the other serves as a register, and also as a handle to the device.* A lot of long words to describe a deliciously simple device!

Analysis of types made, 1871-75, by the editor

The analysis below shows which type of scales were considered unsatisfactory in the early 1870s. Nobody was going to re-invent the wheel, but they would have a go at designing a better scale if they thought it was worth their while, after coping with the complicated process of gaining a patent, arranging for manufacture and selling enough examples to make a profit.

Miscellaneous	115,419	143,499	156,831
	116,999	144,286	158,636
	118,862	144,914	161,098
	119,871	147,388	161,130
	123,621	151,241	161,575
	128,397	152,195	161,576
	128,677	152,752	164,938
	133,289	152,933	165,114
	135,908	153,460	166,046
	138,362	155,391	166,569
	139,372	156,259	166,575

Analysis of Five years' US Patents for scales, 1871-1875

Grain sc, industry size,	110,963	Platform sc,	120,927	Buckets	112,043
	110,965		121,200		142,991
	112,782		123,253		148,197
	113,133		123,564		171,016
	114,737		132,321	Counter steely'ds	114,248
	125,612		139,316		141,556
	126,392		139,897		157,233
	126,749		141,627		163,135
	128,622		146,702		169,415
	129,045		146,944	Cart sc	113,543
	129,222		147,512		140,826
	137,921		150,805		166,389
	144,541		151,689	Sack sc for farmers,	110,707
	148,120		154,362		112,522
	153,396		155,746		118,678
	157,522		155,753		126,732
	169,630		160,381		138,315
	170,965		163,060		143,658
Platform sc,	110,696		163,174		149,082
	111,733		163,423		157,345
	113,529		168,629		162,024
	115,190		168,996		
	115,268		170,191		

The other category of scales that apparently needing improving were platform scales, there being 28 patents for them. These would have been needed by farmers, but they were also widely neededby the new industries that were burgeoning in the cities of America. Many patents refer to relieving the bearings on platform scales, obviously a weak point when scales were heavily used.

Only five patents were for counter scales, which is an exceptionally small number, considering the

Patents sorted by date, (shop/warehouse platform scales and smaller). 1873-1877

NO.	DATE	INVENTOR	RESIDENCE	ASSIGNEE	TYPE
144,914	Nov 25, 1873	A M Maynard	Savoy, MA		Weighing & pricing counter roberval w knives cast into blocks
146,944	Jan 27, 1874	W R Parr	Elba, MN		Dial on pendulum platform scale
147,383	Feb 10,1874	J Foller	Washington, DC		Detachable tare beam on counter roberval
149,082	Mar 31, 1874	S S Waldo & T W Bennett	Eldora, IA		Bag-holder & steelyard
151,241	May 26, 1874	H Paddock	St Johnsbury, VT	H Paddock & F Fairbanks	Spring, fly-wheel, & dial on steely'd postal sc
152,195	June 16, 1874	A Turnbull	New Britain, CT	Landers, Frary & Clark	Shaped case for spring bal
152,933	July 14, 1874	J H Usher	Buffalo, NY		Frame for poises on platform sc
153,460	July 28, 1874	H F Shaw & G F Shaw	Boston, MA		Curved pendulum wall sc
154,362	Aug 25, 1874	W B Wood	Franklin, KY		Folding pillar on platform sc
155,391	Sept 29, 1874	M Scott	Homewood, PA		Spring bal attached to hay fork
155,746	Oct 6, 1874	T Olsen	Philadelphia, PA	Riehlé Bros	Gravity adjustment on platform sc
156,259	Oct 17,1874	W Schmoltz	San Francisco, CA		Modifications to equal-arm bullion sc
156,831	Nov 10, 1874	H M Weaver	Mansfield, OH		Pivoted, taring graduated arc see EQM
157,233	Nov 24, 1874	A A Skinner	Oxford, NY		Ratio salt / butter counter steelyard

157,345	Dec 1, 1874	P P Parker	Parkersburg, IA	P P Parker & M I Powers	Counter steelyard attached to sack holder
158,636	Jan 12, 1875	W W Goodwin	Camden, N J		Micrometer on steelyard photometer
160,381	Mar 2, 1875	L D Berry	Moline, IL	L D Berry & G M Sargent of Des Moines, IA	Design for bearings of platform sc
161,098	Mar 23, 1875	H S Cochran	Philadelphia, PA		Equal-arm sc plus roberval sc, interlinked, one serving as a test for the other
161,130	Mar 23, 1875	T Lanston	Washington, DC		Poise lifting postal sc
161,575	Mar 30, 1875	T Tebow	Lexington, KY		Micrometer poise on steelyard
161,576	Mar 30, 1875	T Tebow	Lexington, KY		Micrometer poise on steelyard
162,024	Apr 13, 1875	H T Budge	Cedar Falls, IA		Holder for sack on steelyard
163,060	May 11, 1875	T Fairbanks	St Johnsbury, VT		Frame pre-cut for check-rods of platform sc
163,135	May 11, 1875	O T Baker	Wamego. KS	O T Baker & O M Gay	Rolling poise on slotted linkage for platform sc
163,174	May 11, 1875	J Foller	Washington, DC		Micrometer poise for platform sc
164,938	June 29, 1875	W T Robinson	Huntsville, TX		Rolling poise & lock on counter sc
165,114	June 29, 1875	R Murdoch	Baltimore, MD		Pillar for steelyards
166,046	July 27, 1875	H M Weaver	Mansfield, OH		Linked twin poises for pendulum post sc
166,569	Aug 10, 1875	A Turnbull	New Britain, CT	Landers, Frary & Clark	Flexure spring letter sc
166,575	Aug 10, 1875	H C Wingate	New Orleans, LA		Dial on levers of counter sc
168,996	Oct 19, 1875	A W Hess	Chicago, IL		Check-rods to prevent sideways oscillation of platform
169,415	Nov 2, 1875	E A Chameroy	Paris, France		Weight registering poise for platform sc
171,016	Dec 14, 1875	A Harper & L W Cross	Edgerton, OH		Spring under bucket
171,650	Jan 4, 1876	J P Chatillon	New York, NY	John Chatillon & Sons	Ice sc
171,670	Jan 4, 1876	W C King	Pittsburgh, PA		Hydraulic postal sc with mercury
171,760	Jan 4, 1876	F Bockhacker	Hückeswagen (sic), Prussia		Hydraulic sc for wool in washing
171,993	Jan 11, 1876	G H Chatillon	New York, NY	John Chatillon & Sons	Half-roberval & spring postal sc
173,168	Feb 8, 1876	J T Guthrie	Leesburg, OH		Removable calculating graduated plates on platform sc
173,669	Feb 15, 1876	W W Reynolds	Brandon, VT	Brandon Mfg Co	Compound lever steely'd on platform sc
173,832	Feb 22, 1876	N Wagner & J Schudt	Williamsburg, NY		Spring bal in refrigerator to weigh ice
174,154	Feb 29, 1876	W W Reynolds	Brandon, VT	Brandon Mfg Co	Modified poises
176,513	Apr 25, 1876	A W Comstock	Mount Pleasant, IA		Many little modifications to platform sc
177,823	May 23, 1876	H Estabrook	Paterson, NJ		Links under drop-lever platform sc
178,188	May 30, 1876	S L Plumb	Portage, WN		Poise-lifting steelyard.
178,358	June 6, 1876	A Carpenter	Angola, IA		Bilateral pendulum early pic D
178,629	June 13, 1876	H L Grisell	Pennville, IA		Price-indicating or apoth drams on counter steelyard
178,673	June 13, 1876	R H C Rhea	Uniontown, KY		Pocket folding steelyard for doctors
179,842	July 18, 1876	P Deland	Little Cooley, PA		Spring weighing bucket
181,099	Aug 15, 1876	A Pangburn	Fremont, OH		Compound levers for platform sc
181,228	Aug 15, 1876	C A Whedon	Cranford, NJ		Compact transference of leverage on platform sc
182,852	Oct 3, 1876	E A Rock	Ludlow, VT		Design of poise on counter steelyard
183,156	Oct 10, 1876	G W Grove	Linnsville, OH		Tare for counter steelyard
183,833	Oct 31, 1875	A Bernstein	Berlin, Prussia		Surreptitious testing of gold coins
185,731	Dec 26, 1876	L W Cross	Angola, IA		Steelyard hidden under deep pan
186,122	Jan 9, 1877	F Fairbanks	St Johnsbury	E & T Fairbanks & Co	Steel insert in brass steelyard
186,149	Jan 9, 1877	A Montgomery	Philadelphia, PA		Padded scoop
186,267	Jan 16, 1877	J V H Nott	New York, NY		Flexure spring bal for letters

huge numbers invented earlier. Maybe shops were reasonably satisfied with the scales they had, and were not in the market for new scales.

Many of these scales were for farmers or for the produce from farms, 9 sack scales, 4 buckets, 3 cart scales and 21 grain scales of industrial size. Farming has always supported enormous numbers of Americans, and Americans were renowned for their enthusiasm for machinery. Because they lived at great distances from each other, each farmer would need to own a lot of machinery, rather than sharing with his neighbours as happened in Europe, so the market for good, robust scales would have attracted scale entrepreneurs.

Howe Revisited

BY J R KATZ

In an article appearing on page 1526 of EQM, I previously reported finding a steelyard postal scale marked 'Howe's, Brandon VT'. That was the first I learned of Howe being in Brandon before Rutland, VT. The thrust of the article was essentially to report on Howe's early location. Since that time I've come across the reference to Brandon Mfg Co, in context with Howe, but assumed it was a term used by Howe while in Brandon. Recently I received a query about this very issue: 'Who was the Brandon Mfg Co, and when?' I decided to delve a bit deeper into Howe, and found the history in some more detail, which I have distilled here.

In 1855, Francis M Strong and Thomas Ross, both great mechanical minds, began studying the perfect weighing device, and in 1856 secured their first patent. They exhibited at fairs where they received favorable attention. In the spring of 1857, John Howe Jr, of Brandon VT, purchased the patent of the inventors and began manufacturing of scales at Brandon, where he retained the services of the two inventors. Things went well and he soon expanded. In 1857, they got a job for a platform scale at the Morris Canal in NJ. In March, 1864, Howe bought the entire interest of Strong and Ross in the patents and the manufacture of scales and the HOWE SCALE CO was organised and continued for five years. Things turned around and became hopelessly insolvent due to poor financial management, and went into bankruptcy in May 1869. The company's entire holdings went up for auction.

At that time there was pressure brought to bear to remove the business out of Brandon, which would have been a blow to the town. However, Nathan T Spague Jr, a true son of Brandon with some wealth, purchased the property and immediately transferred it to a previously chartered corporation, the BRANDON MANUFACTURING CO. In this period, 1869 to 1877, scales can be marked 'HOWE'S / BRANDON Mfg Co / Brandon, VT'. There was a fire in 1872, and things got put back okay. By 1875, they had 250 workmen, but were losing money. Ex-governor John B Page of Rutland, an active member of the corporation, exerted influence for the removal of the plant to Rutland, where it could be near a railhead, and in 1877 the move was made.

The Howe Chronology in brief.

Howe Scale Co, Brandon, VT	1864 to 1869
Brandon Mfg. Co, Brandon VT	1869 to 1877
Howe Scale Co., Rutland, VT	1877 onwards

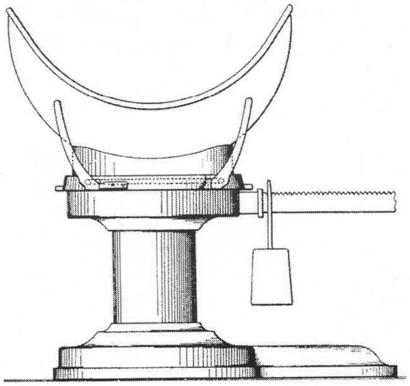


Fig. 1. W W Reynold's grocers' scale, made (as the fat pillar indicates so clearly) by Howe at Rutland VT. Patent no. 260,415 of July 4, 1882.